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Engineering & Environmental Services

A Report Prepared for:

Superfund Program SFD-7-3
US EPA Region IX
Attention: Ms. Alana Lee
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WORK PLAN FOR SULFIDATED ZERO VALENT IRON IN-SITU PILOT TEST SMI HOLDING LLC 455 AND 485/487 EAST MIDDLEFIELD ROAD MOUNTAIN VIEW, CALIFORNIA

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1.0 INTRODUCTION

On behalf of SMI Holding LLC (SMI), PES Environmental, Inc. (PES) is submitting this work plan to implement an in-situ pilot test[1] using sulfidated zero valent iron (ZVI) to treat trichloroethene (TCE)-affected groundwater at the former Sobrato Development Company (Sobrato) properties at 455 and 485/487 and 501/505 East Middlefield Road (EMR) in Mountain View, California (the Site). SMI is implementing the requirements of the 106 Order[2] issued to Sobrato for the Site. The treatment will use flowable, micron-sized zero-valent iron (ZVI)[3]. The ZVI will promote abiotic TCE degradation[4].

ZVI has been selected over in-situ chemical oxidation (ISCO) technology as there is less likelihood for the need for multiple injection rounds. Grid-spaced source area injections are proposed to limit rebound associated with matrix diffusion effects[5]. Injections in a series of rows are also proposed for treatment of the downgradient on-Site groundwater plume. The grid-spaced and injection row approach are discussed in more details in Sections 3 and 4 of this work plan.

The Site is owned and was previously occupied by Symantec, Inc. (Symantec). During a March 12, 2019 site visit associated with the upcoming 2019 fourth five-year review for the Middlefield-Ellis-Whisman (MEW) area, Alana Lee of the U.S. Environmental Protection Agency (EPA) recognized that as the property was now almost completely vacant, it provided an opportunity for SMI to implement aggressive groundwater cleanup[6,7]. This work plan is being submitted to comply with EPA's request.

Both buildings at the Site will be leased to another entity which plans to initiate occupancy in August 2019. A complete tenant vacancy is expected to occur in July 2019. After multiple communications, the property owner has generally agreed to grant access for the remediation work in July 2019[8].

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[1] Although the proposed groundwater treatment will be implemented full-scale at the Site, the proposed groundwater treatment is called a pilot test because it deviates from the groundwater treatment method in the Record of Decision for the MEW area.

[2] EPA, 1990. *Administrative Order for Remedial Design and Remedial Action, Docket No. 91-4.* November 29.

[3] The ZVI that will be used is micron-sized (less than 5 micron), consists of a pre-mixed colloidal suspension liquid with 40% ZVI by weight, and is readily injected.

[4] A more detailed discussion of the treatment technology is included in Section 3.

[5] Sale, 2013. *Management of Contaminants Stored in Low Permeability Zones – a State of the Science Review.* October.

[6] Site meeting of March 12, 2019 included Alana Lee of EPA (and other EPA representatives), Scott Morrison and Susan Gahry of PES, Michelle King of EKI, and Art Gomez of Symantec.

[7] During the March 2019 site visit, PES was advised by Symantec's facility representative (Art Gomez) that the 487 EMR building was completely empty and only 6 employees occupied the 455 EMR building.

[8] Symantec, 2019. Email from Peggy Song to Susan Gahry of PES entitled: "*Re: [EXT] Symantec Building K&L, Mountain View, CA = Fiber Optic Contractor for MV – Results of PES Discussion with Allan Lopiz at Metro Electric & New Questions.*" April 15.

The remainder of this work plan is organized as follows:

- Section 2 provides background information, including the Site clean-up requirements, prior Site investigations, hydrogeologic information, and a summary of prior remedial activities and/or attempts to enhance groundwater remediation;
- Section 3 provides a discussion on groundwater concentration trends, the reagents that will be used, and the long-term project objective;
- Section 4 provides a discussion of the proposed work activities including site access, underground utility location (and clearing all proposed injection locations via air knifing[9]), installation of new monitoring wells and soil vapor probes, the injection plan, the performance monitoring plan, the site restoration plan (which includes resurfacing/restriping of the parking lot and landscape restoration), and implementation reporting. (The proposed work activities also include sealing potential vapor intrusion pathways at 455 EMR and 485/487 EMR and baseline indoor air sampling within 455 EMR and 485/487 EMR);
- Section 5 includes a discussion of quality assurance and quality control (QA/QC) measures;
- Section 6 provides the contingency plan if increased groundwater or soil vapor concentrations are detected; and
- Section 7 provides a schedule for work implementation and performance monitoring submittals.

2.0 BACKGROUND INFORMATION

Site source control activities have been conducted in accordance with the previously referenced 106 Order and May 1989 EPA ROD. The 106 Order requires that SMI undertake activities to adequately control sources originating from the Site. Groundwater clean-up standards for the Site are based on Maximum Contaminant Levels (MCLs) and are 5 micrograms per liter (μg/L) for TCE, 6 μg/L for cis-1,2-dichloroethene (cis-1,2-DCE), and 2 μg/L for vinyl chloride.

2.1 Site Location

The Site is located on the upgradient or south side of the MEW area, along the south side of EMR between Ellis Street and the railroad (Plate 1).

[9] Based on prior discussion's with Symantec's consultant (EKI), hand-augering was requested to clear borehole locations. Air knifing is very similar to hand-augering as the soil is vacuumed out of the locations.

Two buildings, 455 EMR and 487 EMR, may overlie shallow (A-aquifer) groundwater that has been impacted with TCE and cis-1,2-DCE (a degradation product of TCE). The current VOC concentrations detected in groundwater during the most recent monitoring event (November 2018) are shown on Plate 2. The detections include: TCE (up to 650/610 μg/L [duplicate samples] in well R-20A); cis-1,2-DCE (up to 580/650 μg/L [duplicate samples] in well SO-PZ1); and vinyl chloride (up to 110 μg/L in well SO-PZ1 and 99/110 μg/L [duplicate samples] in well SO-PZ2). The deeper B1-aquifer, as characterized by well SO3-B1, has not been impacted with TCE (or TCE degradation products) above clean-up levels.

2.2 Potential Sources of VOCs

2.2.1 On-Site Sources

As shown on Plate 2, two potential sources of volatile organic compounds (VOCs) were identified on the 455 EMR site[10]: (1) waste solvent/neutralization tanks formerly located near the southeastern corner of the 455 EMR building; and (2) suspected releases in the vicinity of the southeastern corner of the 455 EMR site. Results of chemical analyses of soil and groundwater samples from the area south of 487 EMR suggested a release of TCE across the southern portion of the 485/487 EMR property, but it is not known whether these sources were due to on-Site activities and/or off-Site activities[11]. Soil and groundwater impacts above the clean-up levels have not been identified at 501/505 EMR.

2.2.2 Off-Site Sources

An upgradient source of TCE concentrations in groundwater is evident based on historical groundwater chemistry data for regional well R-24A located at 500 Ferguson Drive (ranging from 16 to 22 μg/L between 2003 and 2006[12] and 12 to 16 μg/L between 2009 and 2011)[13]; monitoring data for this well could not be found in the most recent MEW Regional Program report[14].

The property to the south of and directly adjacent to the subject Site is 500 Ferguson Drive. During development of the light rail system at 500 Ferguson Drive in 1991, the top 3 feet of soil excavated adjacent to the Southern Pacific Railroad was placed along the southern boundary of the 455 EMR site[15]. In November 2006, soil vapor testing was completed at

[10] PES, 1993. *Source Investigation and Characterization – Addendum 1, Sobrato Property, 455 East Middlefield Road, Mountain View, California*, July 30, 1993.

[11] PES, 1992. *Source Investigation and Characterization, Sobrato Properties, 485/487 and 501/505 East Middlefield Road, Mountain View, California*, March 30, 1992.

[12] Weiss, 2009. *2008 Annual Progress Report for MEW Regional Groundwater Remediation Program*. June 15.

[13] Geosyntec, 2014. *2013 Annual Progress Report for MEW Regional Groundwater Remediation Program.* March 14.

[14] Geosyntec, 2019. *2018 Annual Progress Report - Regional Groundwater Remediation Program - MEW Superfund Area, Mountain View and Moffett Field, CA*. April 15.

[15] Cornerstone Earth Group, 2015. *Updated Program Level Site Development Plan, South Whisman Precise Plan Area, 100 to 500 Ferguson Drive, Mountain View, California*. February 27.

500 Ferguson Drive on behalf of the City of Mountain View[16], but attempts to obtain a copy of this report have been unsuccessful. VOCs associated with the former GTE site have been detected along the southern property boundary of 500 Ferguson Drive. The City of Mountain View has conditionally approved planned redevelopment of 500 Ferguson Drive (east of the light rail line), including planned residential construction[17]. The City's approval requires vapor mitigation measures (i.e., a vapor mitigation plan and vapor barrier plan) due to the presence of VOCs in the shallow groundwater and soil vapor at 500 Ferguson Drive.

As part of this work plan, two new upgradient monitoring wells are proposed to monitor these potential off-site impacts.

2.3 Prior Site Investigations

Numerous investigations were conducted at the Site involving the collection of soil gas samples, grab groundwater samples (Hydropunch), and soil samples. The locations assessed are shown in Appendix A (figures excerpted from prior investigation reports) and VOC concentrations in the A-aquifer in 1993 (prior to operation of the groundwater extraction system) are included. These prior investigations defined the extent of TCE-impacted soils and the on-Site groundwater plume, with the highest TCE concentrations in groundwater identified near wells SO-2 (historical high of 60,000 μg/L in 1992), SO-PZ1(historical high of 1,200 μg/L in 1993), and SO-PZ2 (historical high of 8,000 μg/L in 1997).

Thirteen groundwater monitoring, four groundwater extraction, eight vertical soil vapor extraction (which due to increased water levels are now screened in the saturated zone), and five air sparging A-aquifer wells were installed on the Site.

2.4 Hydrogeology

A-aquifer materials are generally present at depths ranging from approximately 15 to 30 feet below ground surface (bgs) at the Site. The aquifer materials were likely deposited in alluvial environments.

The majority of the boring logs for the Site indicate the presence of a relatively thick (at least 10 feet) permeable lens or lenses at depths between approximately 15 and 30 feet bgs. The exceptions to this are limited and include well SO-1 (gravel at 25 to 30 feet bgs) and SO-PZ3 (sand at 21 to 23.5 feet bgs and 25.5 to 32 feet bgs). A cross-section location map is provided as Plate 3, with cross-sections A-A', B-B', and C-C' shown on Plates 4 through 6, respectively.

[16] Cornerstone Earth Group, 2015. *Updated Program Level Site Development Plan, South Whisman Precise Plan Area, 100 to 500 Ferguson Drive, Mountain View, California*. February 27.

[17] City of Mountain View, 2015. *A Resolution Conditionally Approving a Planned Community Permit and Development Review Permit to Construct a Mixed-Use Project with 394 Apartment Units and 3,000 Square Feet of Commercial Space in Two 4-Story Buildings Over One Level of Underground Parking at 500 Ferguson Drive*. June 15.

The general groundwater flow direction in the A-aquifer on the Site was historically to the north towards San Francisco Bay. However, subsequent to the installation of a slurry wall surrounding the downgradient Raytheon site located at 350 Ellis Street (the Raytheon site and slurry wall are shown on Plate 1), the groundwater flow direction bifurcated to the northeast and northwest on the northern portion of 455 EMR and 487 EMR. The groundwater gradient, under non-pumping conditions (August 1993 and June 1995), was approximately 0.0015 to 0.002 feet/feet (ft/ft)[18].

In 1993, variable-rate aquifer tests were conducted on A-aquifer wells SO-1 and SO-2 to assess hydraulic properties. The hydraulic conductivity and transmissivity calculated from the tests were 58 to 66 feet per day (ft/day) and 700 to 790 square feet (ft^2) per day (ft^2/day) for well SO-1, and 157-160 ft/day and 2,300 ft^2/day for well SO-2. These results are consistent with the reported lithology at wells SO-1 and SO-2 (both installed by Dames & Moore in 1989). The lithologic log for well SO-1 indicates only a limited thickness of permeable material (silty fine to medium gravel at depths of 25 to 30 feet bgs). The boring log for well SO-2 indicates the presence of more permeable lenses (fine gravel and sandy fine to medium gravel at depths of 16.5 to 27 feet bgs and silty sand at depths of 32.5 to 34.5 feet bgs).

Step-discharge testing was also conducted on wells EW-2 and EW-3 in 2000 by SECOR International, Inc. (SECOR). The results indicated that the maximum sustainable pumping rate at EW-2 and EW-3 was greater than approximately 19 gallons per minute (gpm). The greater sustainable pumping rates at extraction wells EW-2 and EW-3 indicate the presence of relatively high permeable sediments in the vicinity of these wells.

Well EW-4 has not been pump tested, but it is screened in permeable sediments and can produce at least 8 gpm. Well EW-1 is screened in less permeable sediments and has a much lower yield than the other three on-Site extraction wells[19]. Well EW-1 was the first extraction well installed at the Site, which has a sustainable yield of only 0.5 to 1.0 gpm and varies seasonally.

In 2018, additional aquifer testing was competed at the Site[20]. On February 20, 2018 the extraction pumps in wells EW-2 and EW-3 were replaced with higher rated pumps in an attempt to test for increased pumping rates. During pump removal at well EW-3 a mass of roots (approximately the size of a soccer ball) was encountered and removed[21]. Due to concerns of root growth and accumulated sediment affecting well efficiency, well redevelopment was performed for both wells EW-2 and EW-3. Well EW-2 was redeveloped

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[18] SECOR, 1998. Final *Report Operation and Maintenance Plan for 455, 485/487, and 501/505 East Middlefield Road, Mountain View, California*. February 20.

[19] The lithologic log for EW-1 log indicates a higher amount of fine-grained material (i.e., approximately 30% silt/clays within the screened interval of 13 to 33 ft bgs), whereas the log for EW-3 indicates 0% silt/clays for that depth interval.

[20] PES, 2018. *Results of Aquifer Testing Program, SMI Holding LLC, 455, 485/487 and 501/505 East Middlefield Road, Mountain View, California*. October 30.

[21] In March 2017, a 7-foot long root ball was removed from well EW-3 as the pump was stuck in the roots from the three nearby trees. A long-term solution to remedy the root-intrusion issue would require tree removal, over-drilling, and reconstructing a new well.

using a full-size Smeal rig, and well EW-3 was redeveloped using a limited access GeoProbe 7720DT rig (as a full-size rig could not be used due to access constraints resulting from the trees, sidewalk, and roadway). After redevelopment of EW-2, the achievable pumping rate increased from 10 to 25 gpm. After redevelopment of EW-3, the achievable pumping rate increased from 10 to 15 gpm; however, significant drawdown was observed and estimates of well efficiencies for various discharge rates ranged from approximately 20 to 40 percent (%)[22]. The maximum achievable pumping rate at well EW-3 has subsequently dropped to 7 gpm (due to root intrusion from the nearby trees). A plan to replace well MW-3 was in the progress of being negotiated with the property owner when it was learned that the property was vacant.[23]

The 2018 aquifer test findings included:

- The transmissivity value in the vicinity of EW-2 range from 2,030 to 9,550 ft^2/day (geometric mean of 4,690 ft^2/day), and the corresponding estimated hydraulic conductivity values range from 75 to 479 ft/day (geometric mean of 235 ft/day). The calculated transmissivity and hydraulic conductivity values are consistent with previous aquifer testing data from well SO-2 and indicate the alluvial aquifer is moderate to highly permeable;

- Storativity results are generally consistent for an unconfined alluvial aquifer and may be influenced by the proximity of paleochannels;

- Estimates of groundwater flow velocity range from approximately 1.3 ft/day or 475 feet/year (ft/yr) to 2.2 ft/day or 803 ft/yr, which is consistent with the previous estimate of 1.6 ft/day (600 ft/yr) presented in the previously referenced 2017 ZVI work plan; and

- Hydraulic communication between the A- and B-aquifers is negligible. As previously noted, the deeper B1-aquifer, as characterized by well SO3-B1, has not been impacted with TCE at the Site above clean-up levels in the vicinity of the potential source areas at the 455 EMR site.

2.5 Remedial Activities

Remedial activities were initiated at the Site in 1995. An air sparging/soil vapor extraction (AS/SVE) pilot test was conducted at the Site between October 1995 and March 1996. In 1997, a full-scale AS/SVE system was installed. Four source control recovery wells (SCRWs), or groundwater extraction wells (EW-1, EW-2, EW-3, and EW-4), were also installed in the A-aquifer and the projected groundwater extraction system flow rate was 9 gpm, as discussed in the Operation and Maintenance Plan (O&M Plan)[24].

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[22] Typically, well efficiencies range from approximately 70 to 80% (or greater).

[23] The plan to replace well EW-3 has been put on hold as it is anticipated that prolonged operation of the pump-and-treat system will not be needed after implementing the treatment proposed in this work plan. Well EW-3 will continue to be used as a monitoring well.

[24] SECOR International, Inc. 1998. *Final Report Operation and Maintenance Plan for 455, 485/487, and 501/505 East Middlefield Road, Mountain View, California.* February 20.

Because three of the four extraction wells yielded more groundwater than expected (wells EW-2, EW-3, and EW-4 are screened in more permeable sediments than EW-1), the system flow rate (with all four wells operating) was about twice as high (18 gpm) as that projected. Extracted groundwater was initially treated by two 300-pound granular activated carbon (GAC) vessels in series, but was later treated through two 1,000-pound GAC vessels in series. Since December 2018, three 1,000-pound GAC vessels in series are used to treat the groundwater.

The AS/SVE system operated for only a short time, as rising water levels forced closure of the vertical AS/SVE wells. Between 1991 and 1998, the water levels rose by approximately 12 feet. The SVE system continued to operate with the horizontal well and extracted vapors were treated by vapor phase GAC. Regulatory closure of the SVE system was obtained in 2001 following confirmatory soil sampling to verify that soil clean-up goals were achieved.

An ISCO pilot test using potassium permanganate to reduce groundwater VOC concentrations was conducted at the Site in November and December 2000, with the highest volume of potassium permanganate solution injected near the well with the highest VOC concentrations (well SO-PZ2). Residual effects of this treatment were noted; the TCE groundwater concentration in the area treated most extensively (near well SO-PZ2) was reduced from the pre-injection concentration of 2,900 μg/L to less than 600 μg/L after injection. Further injection of potassium permanganate solution to further reduce groundwater concentrations in the source area was proposed in September 2002, but EPA approval was never received.

In 2002, groundwater concentration trends began to indicate that biological degradation was likely occurring in the area near well SO-PZ2 (as evidenced by the increasing concentrations of cis-1,2-DCE, which is a daughter product of TCE). Subsequent geochemical tests of groundwater samples from well SO-PZ2 in 2003 (see Table 2) indicated that the source area groundwater was anaerobic, rather than aerobic, and it was thus, favorable for application of a reductive (anaerobic) remediation method.

As a voluntary measure to further assess methods to facilitate Site remediation, SMI conducted an enhanced reductive dechlorination (ERD) laboratory microcosm study between January and April 2003 using a groundwater sample collected from well SO-PZ2 in December 2002[25]. Various electron donors were tested as well as bio-augmentation and the results were favorable. In January 2004, PES advised the EPA that SMI no longer desired EPA's approval for additional source area chemical oxidation treatment. Instead, SMI desired to move forward with ERD on-Site pilot testing. The proposed ERD pilot test was discussed with the EPA during a meeting on January 26, 2004. A work plan to implement ERD at the Site was submitted on March 2, 2004. Comments from the EPA were received on April 8, 2004. However, implementation of the ERD pilot test never occurred due to concerns of the prior property owner.

[25] PES, 2004. *Work Plan for Enhanced Reductive Dechlorination Implementation, Former Siemens/Sobrato Properties,* 455*,485/487, and 501/505 East Middlefield Road, Mountain View, California.* March 2.

In April 2007, due to the declining concentrations of TCE measured in groundwater samples from extraction well EW-4, elimination of pumping from well EW-4 was recommended[26]. To optimize VOC mass removal, increased pumping from extraction well EW-2, which is located closer to former source areas and wells with higher VOC concentrations than EW-4, was also recommended. On April 30, 2007, PES submitted an email to the EPA to document the EPA's approval of shutting down EW-4 and increasing extraction from well EW-2. On May 11, 2007, well EW-4 was turned off. On May 17, 2007, a larger pump was installed in well EW-2 and the extraction rate was increased.

2.6 2008 Remedial Optimization Evaluation

In September 2008, a remedial optimization report for groundwater was prepared[27]. The findings documented in this report included:

- Even though groundwater remediation may be expedited with the use of alternative technologies, the groundwater RAO of 5 μg/L of TCE may not be achievable in a reasonable time period[28];
- ERD is the preferred alternative technology for addressing VOCs in groundwater at the Site, rather than oxidation (ISCO) technologies or continued operation of the groundwater extraction and treatment (pump-and-treat) system; and
- After ERD is implemented at the Site, a subsequent remedial phase consisting of groundwater monitoring only is the likely next step. Alternatively, groundwater clean-up goal modification should be explored.

When the 2008 remediation optimization evaluation was completed, the formation of adverse by-products associated with ERD (i.e., methane and vinyl chloride) were not considered to be of concern. Since that time, at least one Bay Area site[29] has documented issues with excessive methane formation. Should an ERD remedy be proposed, it is now understood that an extensive soil vapor and sub-slab monitoring program would likely be required.

2.7 2017 ZVI Work Plan

In 2017, a work plan was submitted to EPA to utilize in-situ chemical reduction using ZVI to minimize the potential for the formation of vinyl chloride and methane[30]. The ZVI proposed for use was larger diameter (i.e., 15 to 500 microns) and thus, more difficult to inject than the

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[26] PES, 2007. *2006 Annual Progress Report, SMI Holding LLC, 455, 485/487, and 501/505 East Middlefield Road, Mountain View, California.* April 3.
[27] PES Environmental, Inc., 2008. *Remedial Optimization Evaluation Report, SMI Holding LLC, 455, 485/487, and 501/505 East Middlefield Road, Mountain View, California.* September 2.
[28] PES Environmental, Inc., 2008. *Remedial Optimization Evaluation Report, SMI Holding LLC, 455, 485/487, and 501/505 East Middlefield Road, Mountain View, California.* September 2.
[29] Teledyne/Spectra Physics Site, Mountain View, California.
[30] PES, 2017. *Work Plan for In-Situ Chemical Reduction (Zero Valent Iron) Pilot Test, SMI Holding LLC, 455 and 485/487 East Middlefield Road, Mountain View, California.* May 31.

reagent currently proposed for use. The ZVI proposed for use was not sulfidated; as explained in more detail in Section 3, sulfidated ZVI improves the removal of VOCs. The ZVI work plan was never implemented.

3.0 CHEMICAL CONCENTRATIONS, TECHNOLOGY DESCRIPTION, AND LONG-TERM PROJECT OBJECTIVE

The following sections provide a discussion of groundwater concentration trends and the reagents that will be used to implement ZVI, and the long-term project objective.

3.1 Chemical Concentrations in Groundwater

Historical COC concentrations detected in groundwater monitoring wells at the Site are summarized in Table 1. Historical TCE and cis-1,2-DCE concentrations trends in the individual monitoring wells are presented in Appendix B.

3.1.1 Historical High Concentrations

As shown on Table 1 and previously discussed, historically, the maximum TCE concentrations were found in source area wells SO-2 (60,000 μg/L detected in February 1992) and SO-PZ2 (8,000 μg/L detected in December 1997). Since 2000, the TCE concentrations in well SO-2 have been less than 100 μg/L, with 37 μg/L detected in November 2018; only low concentrations of cis-1,2-DCE have been detected in samples from well SO-2, with a maximum of 6.1 μg/L in March 1996 and 2.1 μg/L in November 2018.

Historically, the maximum cis-1,2-DCE concentrations have been detected in source area well SO-PZ2. TCE and cis-1,2-DCE concentrations have exhibited fluctuations in samples from well SO-PZ2, with TCE concentrations below 510 μg/L since January 2006 and a maximum cis-1,2-DCE concentration of 3,600 μg/L in December 2001. In November 2018, TCE and cis-1,2-DCE concentrations in well SO-PZ2 were 210/250 μg/L and 580/650 μg/L (duplicate samples), respectively.

3.1.2 Recent (November 2018) High Concentrations

The highest total VOC concentrations (i.e., combined TCE, cis-1,2-DCE, and vinyl chloride concentrations) were detected during the November 2018 event in source area wells SO-PZ2 (total VOCs at 904/1,023 μg/L [duplicate samples]) and SO-PZ1 (total VOCs at 258 μg/L). Two wells in the dissolved plume area at the northern boundary of the Site contained the next highest total VOC concentrations (well R-20A at 672 μg/L and well C-3 at 102 μg/L). (There are no wells located between the source area wells and wells at the northern boundary of the Site, but three new wells are proposed in this area as discussed subsequently in this work plan).

Total VOC concentrations in the other wells range from 3.6 μg/L (well R-48A, located upgradient and southeast of the source area) to 72 μg/L (extraction well EW-2, located near the source area at the southeast corner of the 455 EMR building).

In November 2018, the maximum TCE concentration was detected in downgradient well R-20A (at 650/610 μg/L [duplicate samples]). The concentration of cis-1,2-DCE fluctuates in this well and was detected at 22/19 μg/L (duplicate samples) in November 2018.

In November 2018, the maximum cis-1,2-DCE concentration was detected in source area well SO-PZ2 (at 580/650 μg/L [duplicate samples]). During this monitoring event, TCE was detected in this well at a concentration of 210/250 μg/L (duplicate samples).

Vinyl chloride has also been detected in a few Site wells, but is most predominant in source area wells SO-PZ2 and SO-PZ1. In well SO-PZ2, vinyl chloride was first detected in 2005 (at concentrations of 40/43 μg/L [duplicate samples]). In November 2018, vinyl chloride was detected in this well at concentrations of 99/110 μg/L (duplicate samples). In well SO-PZ1, vinyl chloride was first detected in 2008 (at a concentration of 2.6 μg/L). In November 2018, vinyl chloride was detected in this well at a concentration of 110 μg/L. Vinyl chloride has only been sporadically detected in well C-3 (in 2014 at concentration of 10 μg/L) and well R-20A (detected at 0.50 μg/L in 2014 and at 15 μg/L in October 2016).

3.2 TCE Degradation Pathways

Degradation of TCE proceeds by two known pathways: (1) the hydrogenolysis or reductive dechlorination pathway whereby TCE degrades sequentially to cis-1,2-DCE, vinyl chloride, ethene, ethane along with methane formation; and (2) the beta-elimination pathway, which bypasses the formation of biological degradation daughter products cis-1,2-DCE and vinyl chloride with TCE transformed directly to ethane with the interim generation of non-toxic short-lived intermediates, such as chloroacetylene and acetylene[31]. These pathways are shown on Plate 7. ZVI promotes the beta-elimination pathway.

3.3 Sulfidated ZVI Technology Description

ZVI is a strong reducing agent know to reduce TCE and other VOCs to ethene and ethane via the abiotic degradation pathway. The ZVI proposed for use is sulfidated, micron-sized, and colloidal.

Sulfidated ZVI has less side reaction with water, enhanced reactivity with TCE, and increased longevity than unsulfidated ZVI.[32] The reaction of water with ZVI (also known as a corrosion reaction) forms hydrogen (H_2) and is considered to be a competing natural reductant demand process. The reaction of water with ZVI can cause the formation of a passive (or oxidized)

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[31] Cook, 2009. *Assessing the Use and Application of Zero-Valent Iron Nanoparticle Technology for Remediation at Contaminated Sites. (Prepared for US EPA)*. August.

[32] EST, 2017. *Mechanochemically Sulfidated Microscale Zero Valent Iron: Pathways, Kinetics, Mechanism, and Efficiency of Trichloroethylene Dechlorination*. Environ. Sci. Technol. 2017, 51, 12653-12662.

layer on the ZVI which effects the ZVI reactivity and longevity. With sulfidation, the ZVI is surface-treated with a reduced sulfur species and thus, the side reaction with water is minimized[33]. ZVI sulfidation forms iron sulfides on the particle surface to favor the degradation of VOCs rather than the reduction of water.

Micron-sized ZVI is easier to inject than larger sizes of ZVI and avoids the clumping associated with nano-sized ZVI. The micron-sized ZVI is suspended in a colloidal solution to allow the solution to be dispersed into the formation without fracturing or mechanical mixing in the subsurface.

The subsurface materials are heterogeneous and contain areas of fine- and coarse-grained materials. The more permeable coarse-grained materials provide preferential flow paths for groundwater, while the fine-grained materials provide sorption/storage sites for VOCs (which causes matrix diffusion). The heterogeneous distribution of fine- and coarse-grained materials in the subsurface and preferential permeable pathways also inhibit distribution of injected reagent. Heterogeneities in the subsurface are an inherent issue associated with in-situ remedial technologies that rely on injection and distribution of amendments in the subsurface[34].

3.4 Reagents Utilized

The reagent selected to implement abiotic degradation or in-situ chemical reduction (ISCR) at the Site will be provided by Regenesis Remediation Services, Inc. (RRS) of San Clemente, California. The reagents include sulfidated[35] micro-sized ZVI (AquaZVI™ and Chemical Reducing Solution (CRS™).

AquaZVI™ is a sulfidated, micron-sized (less than 5 microns), colloidal suspension of 40% by weight ZVI in an aqueous medium. This reagent promotes the destruction of VOCs on contact. As AquaZVI™ is sulfidated, it has an extended longevity as compared to unsulfidated ZVI. Although this product is micron-sized which makes it easy to inject, it does not cause clumping as occurs with smaller nano-sized particles.

CRS™ is a liquid form of iron (a mix of water and ferrous gluconate) that is easily injected, and will distribute farther in the subsurface than micron-sized ZVI. The ferrous iron in CRS will help facilitate the chemical reduction (abiotic) pathway for VOC degradation.
The reagent specification sheets are included in Appendix C of this work plan. The ZVI treatment is described in greater detail in Section 4.

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[33] Regenesis, 2019. *Zero-Valent Iron Technical Bulletin, Benefits of Sulfidation*. https://regenesis.com
[34] ITRC, 2008. *Technical/Regulatory Guidance, In-Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones*. June.
[35] ES&T, 2017. *Mechanochemically Sulfidated Microscale Zero Valent Iron: Pathways, Kinetics, Mechanism, and Efficiency of TCE Dechlorination*. Environ. Sci. Technol. 2017, 51-12653-12662.

3.5 Long-Term Project Goal

The existing remedial system was designed to control on-Site sources of VOCs, using the groundwater extraction wells (SCRWs). Per the EPA-approved "General Criteria for Suspending Operation of SCRW", when downgradient concentrations are the same as upgradient concentrations, the SCRWs are to be shut-off, with monitoring for one year to evaluate whether rebound occurs[36]. EPA has advised that the comparison of upgradient and downgradient VOC concentrations must also include the VOC concentrations within the central portion of the property including the former source area. During and at the completion of the pilot test and performance monitoring period, EPA will determine whether the groundwater extraction and treatment system may remain off and must approve extending the pilot test or monitoring period[37]. To more effectively monitor upgradient concentrations, two new upgradient monitoring wells will be installed as discussed subsequently in this work plan. A two-year post-injection monitoring program is also proposed to verify the effectiveness of the proposed remedial approach.

SMI's ultimate objective for groundwater remediation at this Site is to acquire EPA's approval to permanently shut down the groundwater extraction system and discontinue facility-specific groundwater monitoring and reporting.

4.0 DESCRIPTION OF PLANNED ACTIVITIES

The planned activities to implement in-situ chemical reduction (ISCR) at the site are discussed below.

ISCR will be implemented in a grid-spaced manner in the source area (vicinity of wells SO-PZ1 and SO-PZ2 where the highest residual TCE and cis-1,2-DCE concentrations are present in groundwater (and the highest potential for matrix diffusions exists). ISCR will also be implemented in the mid-plume and downgradient on-Site plume area using four rows of injections spaced approximately 50 feet apart. New wells are proposed between the rows (where no wells exist), with the anticipation that these wells can be installed in advance of the actual injections so the sampling results can be used to potentially adjust the injection approach, if warranted. The preliminarily proposed injection point locations (which are subject to relocation based on Site features such as sidewalks and underground utilities [Plate 8]) are depicted on Plate 9. The activities that will be completed are discussed below.

- Obtain access to the Site;

- Conduct preliminary field activities, including sealing conduits in the electrical rooms and other potential pathways to minimize the potential for vapor intrusion, and baseline indoor air sampling;

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[36] Smith Environmental, 1996. *Revised Final Design, Regional Ground Water Remediation Programs, South of U.S. Highway 101, Middlefield-Ellis-Whisman Site, Mountain View, California*. January.
[37] EPA, 2019. *Email from Alana Lee of EPA to Sue O'Connor of SMI*. June 5.

- Identify underground utilities using traditional locating techniques. A current map of underground utilities will also be requested from the property owner, if available (a 2009 map of underground utilities is included as Plate 8);
- Air knife or hand auger clearance at proposed drilling locations to a depth of 5 feet bgs and backfill with bentonite;
- Install five new monitoring wells and four permanent soil vapor probes;
- Perform baseline sampling to assess pre-injection groundwater, soil vapor, and indoor air conditions;
- Mix the reagents on-Site with water (obtained under permit from a nearby City fire hydrant) and inject the reagents using direct-push methodology;
- Conduct post-injection groundwater monitoring to assess the effectiveness of the treatment; and
- Conduct post-injection soil vapor monitoring to assess for the potential for increased VOC concentrations associated with the injections.

A more detailed discussion of each of the above tasks follows.

4.1 Site Access

SMI expects the access agreement to implement this work plan will be obtained upon EPA approval of this Work Plan.

With EPA's approval, SMI plans to shut down the groundwater extraction system during the proposed injection activities and post implementation monitoring period. If kept on during and subsequent to the injection activities, the extraction system may pull injected reagents toward the extraction wells and create preferential pathways for reagent distribution, thus potentially adversely affecting the effectiveness of both the ZVI treatment and the pump and treat system. A contingency plan that could result in resumed operation of the groundwater extraction system is included in this work plan.

4.2 Preliminary Field Activities

SMI has submitted well construction permit applications to the Santa Clara Valley Water District (SCVWD) and the permits have been obtained. An addendum to the existing Site-specific health and safety plan will be prepared to cover the planned activities, if needed.

As the buildings will be empty, they will be resurveyed for potential vapor intrusion pathways (pathways). Previously identified pathways that could not be previously sealed (due to Site occupancy) will be sealed. The known pathways that will be sealed include beneath the large electrical panels in the electrical rooms at both 455 EMR and 487 EMR (with work completed by a PES licensed electrician subcontractor) and the fire riser that is contained within a false building column at 487 EMR. If other potential pathways are identified, these will also be sealed.

4.3 Underground Utility Locating

The existing underground utility map is dated (it was prepared in 2009, see Plate 8). PES will subcontract with a private utility-locating firm to assess the presence of underground utilities, verify the underground utility locations provided in 2009, and develop an updated underground utility map[38].

PES has contacted the City of Mountain View and PG&E to obtain current copies of available underground utility maps (which include only those features in the City street, but may be helpful in locating on-Site connections). PES has also contacted Underground Service Alert (USA) to mark known utilities in the street.

PES has met with the property owner's fiber optic provider[39] to better understand the location of these lines. The purpose of this meeting was to evaluate whether the fiber optic lines were lain with copper tracer wire to allow accurate utility location and/or whether the new tenant has plans to install new fiber optic lines since the existing lines are wirelessly connected to the property owner’s main facility[40]. After the underground utilities are assessed and other Site features that may interfere with injections are located (i.e., hills, sidewalks, signs, etc.), the injection points will be located. Injection locations will be at least 5 feet away from existing or new monitoring/extraction wells (and former AS/SVE wells) to minimize the potential for reagent short-circuiting to the surface via the wells.

At all injection (see Plate 9) and new monitoring well locations (see Plate 10), hand-augering or air-knifing will be used to clear the first 5 feet for utilities. Air knifing uses the injection of high-pressure air in conjunction with vacuum soil removal equipment and will be completed by Badger Daylighting of Martinez, California. Air knifing is typically used at locations where underground utilities are dangerous (i.e., gasoline service stations). If completed in advance of injections, the air knife test holes will be sealed with bentonite so that an open borehole is not left at the Site prior to subsequent injection activities (the injections and new monitoring wells will be over-drilled through the existing bentonite-filled borehole).

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[38] PES understands that an access agreement is not needed to begin the site utility location mapping.
[39] SMI will pay costs for the fiber optic provider.
[40] PES met with the previous property owner’s fiber optics subcontractor and was advised that copper lines were installed to allow the lines to be located by energizing the copper lines.

4.4 New Groundwater Monitoring Well Installation

New monitoring wells will be installed and sampled prior to the injection activities in order to establish the pre-treatment baseline conditions at the Site. The monitoring results for the new wells may also be used to modify the injection plan, as warranted (and if time allows). This work will preferably be completed in June 2019 (depending on when the property owner will grant access), so the sampling results are available prior to the actual injections[41].

Five groundwater monitoring wells, two upgradient wells (SM-1 and SM-2) at the southern boundary of the Site to monitor impacts from off-Site and three (SM-3 through SM-5) within the mid-plume area (downgradient of the source area and in between the injection rows), will be installed. The wells will be installed in the shallow zone and screened from approximately 15 to 30 feet bgs; the screened interval may be adjusted based on the lithologic logging results. A total of four soil vapor probes (SV-01 through SV-04) are proposed near the buildings. The probes will be constructed with the vapor intake at approximately 7 feet bgs.

The location of the proposed monitoring wells and soil vapor probes are shown on Plate 10. The monitoring well and soil vapor probe installation procedures are discussed in Appendix D and Appendix E, respectively.

4.5 Baseline Groundwater, Soil Vapor, and Indoor Air Sampling

Prior to injections, groundwater, soil vapor, and indoor air monitoring will be completed to establish pre-treatment (baseline) conditions. Table 3 provides a summary of laboratory methods and associated detection limits for groundwater baseline sampling. Baseline monitoring results will be tabulated and submitted to EPA and the property owner via email.

4.5.1 Baseline Groundwater Monitoring

Baseline groundwater sampling will be performed using low-flow sampling methodology[42] at six existing and five new monitoring locations, including (see Plate 10 for well locations): (1) upgradient of the treatment areas at wells SM-01, SM02, and R-21A; (2) within the treatment areas at wells SO-PZ1 and SO-PZ2 in the source area and at new wells SM-03 through SM-05 and wells R-20A and C-3 in the mid and distal plume area; and (3) downgradient of the treatment areas at well R-15A. The monitoring well sampling procedures are discussed in Appendix D. During sampling, pH, DO, ORP, conductivity, turbidity, and temperature will be measured using field meters (i.e., during low flow sampling with a YSI Pro Plus meter equipped with a flow-through cell). Ferrous iron (II) will also be measured using a field (Hach) test kit.

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[41] If new locations are selected, these locations will be cleared via air knifing to a depth of 5 feet bgs prior to drilling.

[42] Puls, R.W. & Barcelona, M.J., 1996. USEPA Ground Water Issue. *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures*. Publication Number EPA/540/S-95/504. April.

The groundwater samples will be analyzed for:

- Nitrate [as nitrogen] and sulfate using EPA Method 300.0);
- Ferric iron (III) using EPA Method 200.8;
- Dissolved gases (i.e., methane, ethane, ethene, and acetylene) at wells R-20A, SO-PZ2 and the five new wells using Test Method AM20GAX;
- Carbon dioxide using method RSK-175; and
- VOC using EPA Method 8260. These VOC concentrations will serve as the baseline measurements to evaluate the overall effectiveness of this technology.

Groundwater samples for dissolved gases (methane, ethane, ethene, and acetylene) analyses will be transported under chain-of-custody documentation to Pace Analytical (Pace) in Pittsburgh, Pennsylvania (which has a lower reporting limit) than local laboratories. The remaining groundwater samples will be transported under chain-of-custody documentation to Eurofins TestAmerica (TestAmerica), of Pleasanton, California.

4.5.2 Baseline Soil Vapor Sampling

Baseline soil vapor sampling will be collected at the four soil vapor probes screened at 7 feet bgs, along the perimeter of the treatment areas (near the buildings). The soil vapor sampling procedures are discussed in Appendix E. After sampling, the Summa canisters will be transported under chain-of-custody protocol to KPrime. The soil vapor samples will be analyzed for:

- Select VOCs (i.e., TCE, cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride) using EPA Method TO-15; and
- The propellant tracer 1,1-difluoroethane (1,1-DFA) using EPA Method TO-3.

4.5.3 Baseline Indoor Air Sampling

Baseline indoor air sampling will be collected in both buildings (455 and 485/487 EMR). The indoor air within 455 and 485/487 EMR will be sampled for baseline conditions. The previous EPA-approved work plan for indoor air sampling will be utilized[43] and a walk-through with EPA will be completed to select sampling locations if required by EPA. The indoor air samples will be sent under chain-of-custody to KPrime, Inc. (KPrime) of Santa Rosa, California for analysis of TCE and its degradation products, i.e., cis-1,2-DCE and vinyl chloride using EPA Method TO-15 select ion monitoring mode (SIM).

[43] PES, 2014. *Building Specific Indoor Air Sampling Plan, SMI Holding LLC< 455 and 485/487 East Middlefield Road, Mountain View, California*. September 2.

4.6 Reagent Injection Procedures

The reagents will be applied by Regenesis Remediation Services, Inc. (RRS) under PES oversight. A California licensed C-57 driller will advance the boreholes for the injection points. Mix water will be obtained from a fire hydrant under a City of Mountain View permit. Soil borings will be backfilled and sealed with grout after injection.

Equipment utilized during the injections will include: direct-push drilling rigs; two 350-gallon mix tanks and pump (which will be mounted in a portable trailer); hoses (with meters) to convey water from the fire hydrant to the mix tank and from the mix tank to the drilling rig; and totes and/or drums for the reagents. The reagents will be injected using a positive displacement electrically powered pump capable of injecting at pressures of 30 to 50 pounds per square inch (psi).

The anticipated radius of influence as calculated by RRS ranges from 4.8 feet (for the source area) to 5.1 feet (for the downgradient rows). The spacing between injection boreholes is 8 feet such that there will be overlapping coverage between boreholes. Thus, chase water will not be utilized (and chase water is not expected to move ZVI).

4.6.1 Source Area Injections

The source area is approximately 10,000 ft^2. As discussed in Section 2.4, the shallow permeable zone beneath the Site is approximately 15 feet thick and present at depths between approximately 15 and 30 feet bgs. The reagent application in the source area will target this shallow permeable zone. A total of 83 injection points on 8-foot centers with 15 feet between rows will be used to cover the source area (as previously advised, the injection point locations may be adjusted based on the underground utility/Site feature survey results). Approximately 27,000 lbs. of micron-sized, sulfidated ZVI (AquaZVI™ and 4,400 pounds of CRS™ will be required for the source area injections. A total of approximately 66,680 gallons of mixing water will be required, resulting in a total volume of approximately 69,000 gallons of reagent mixture for the source area. The volume of reagents to be injected into each point are discussed in Section 4.7.

4.6.2 Mid and Distal Plume Injection Rows

Four injections rows measuring between 70 and 140 feet long and spaced approximately 50 feet apart are proposed for the mid and distal plume on-Site area as shown on Plate 9. Similar to the source area injections, the injections in the mid and distal plume area will target the shallow permeable zone. A total of 49 injection points on 8-foot centers will be used to cover the four injection rows. Approximately 39,000 pounds of AquaZVI™ and 5,200 pounds of CRS™ will be required for the four injection rows. A total of approximately 41,500 gallons of mixing water will be required, resulting in a total volume of approximately 44,700 gallons of reagent mixture for the mid and distal plume area. The volume of reagents to be injected into each point are discussed in Section 4.7.

4.7 Reagents Mixing and Injection

Prior to injection, AquaZVI™ and CRS™ will be mixed with water. The AquaZVI™ will quickly reduce the ORP/DO of the mix to create anaerobic water.

At the source area, the target injection volume of the reagent mixture is approximately 831 gallons per injection point (with approximately 21.5 gallons of AquaZVI™ and 6.05 gallons of CRS™ at each injection point). A direct-push Geoprobe® rig with retractable screen tooling will be used for injection with the solution applied at approximately 55 gallons per vertical foot. As discussed in Section 4.6.1, a total of 69,000 gallons of reagent mixture are estimated for the 83 proposed injection points in the source area.

At the mid to distal plume area, the target injection volume of the reagent mixture is approximately 912 gallons per injection point (with approximately 52.7 gallons of AquaZVI™ and 12.1 gallons of CRS™ at each injection point). A direct-push Geoprobe® rig with retractable screen tooling will be used for injection with the solution applied at approximately 60 gallons per vertical foot. As discussed in Section 4.6.2, a total of 44,700 gallons of reagent mixture are estimated for the 49 proposed injection points (i.e., the four injection rows) in the mid and distal plume area.

Based on the hydrogeology information collected for the Site (see detailed discussion in Section 2.4) and prior permanganate injection activities[44], it is anticipated that the formation would allow for an injection rates of 2 to 7 gpm and at pressures between 30 to 50 psi at both source and mid and distal plume areas. The actual flow rates and injection pressures will be monitored during injection to provide an indication of the subsurface lithology, with higher flow rates and lower pressures expected to be encountered when injecting into high permeability sediments. Water levels in groundwater monitoring wells in and near the treatment areas will be monitored during injections to minimize the potential for mounding, which could facilitate plume migration. Should water in the nearby monitoring wells increase by more than 1-inch in a 1-hour period, the injection rate will be reduced. Field modifications to the injection methodology may be made, if necessary, to ensure the desired quantities of reagents are injected. Field records will document injection rate, injection method, injection pressure, water level measurements, volume of water used, and the amount of reagents used at each injection point, as well as any deviations from this work plan.

Injection activities are estimated to require approximately eleven days for the source area and seven days for the mid and distal on-Site plume (i.e., the injection rows). If necessary, work will also be completed during the weekend.

[44] PES, 2001. *Chemical Oxidation Pilot Test Report, Siemens-Sobrato Properties at 455, 4895/487, and 501/505 East Middlefield Road, Mountain View, California*. September 14.

4.8 Site Restoration

After injection activities have been completed, the ground surface at the work area will be restored to match the pre-injection conditions. Resurfacing and restriping of the asphalt pavement will be conducted as well as landscape restoration, as needed.

4.9 Post-Injection Groundwater and Soil Vapor Monitoring

The procedures and analytical programs for post-injection groundwater monitoring will follow the same procedures as previously discussed for the baseline sampling in Section 4.5.

Post-injection groundwater monitoring will be performed monthly for the first three months and then quarterly for up to two years after the injection. Groundwater monitoring results will be assessed using a "multiple lines of evidence" approach, as it is possible that one or more of the parameters will deviate from expected conditions. The primary indicator of ZVI effectiveness will be a reduction in VOC concentrations with time and increased production of ethane/ethene gas. Changes in DO, ORP, nitrate, and sulfate concentrations area are also expected.

Post-injection soil vapor monitoring will be initiated within four weeks of the injections and will subsequently performed quarterly for up to two years after injection. Soil vapor monitoring may be discontinued if no substantial changes are noted (with EPA approval).

Semi-annual or annual water level monitoring (as required by EPA) will continue to be conducted in accordance with the Regional Program.

4.10 Implementation Reporting

Documentation of the results of the baseline sampling, injection activities, post-injection monitoring results, and apparent effectiveness of the ZVI treatment at the Site will be provided in periodic reports. The reports will be issued quarterly[45] during the first year following the injection activities, and semi-annually for the remaining monitoring period. The information reported will include an evaluation of geochemical conditions in groundwater near the injection areas, the resulting effects on VOCs concentrations in groundwater, as well as the laboratory analytical reports, and tabulations of field and laboratory results. The results will also be discussed in the annual report (which will satisfy the requirements for one of the quarterly and/or semi-annual reports).

At the end of the treatment period (i.e., after approximately two years), a summary report will be issued to document the effectiveness of the treatment. The trends in VOC removal prior to and after treatment will be compared to assess whether the treatment reduced VOC concentrations in groundwater more quickly than the existing remedial system. However, it is recognized that because VOC groundwater concentrations in wells SO-PZ1 and SO-PZ2

[45] Quarterly reports may be abbreviated and will include tabulation of results and supporting plates. These reports will be submitted to EPA/property owner via email. Laboratory analytical reports will be provided upon request.

(and other wells in the source area) already appear to be degrading reductively, and were likely influenced by the prior permanganate treatment, the VOC degradation trends in these wells may not be appropriate for such a comparison; for these wells, the post-injection trends will be evaluated separately from the trends that existed prior to injections. The summary report will also include recommendations for further actions at the Site, such as transitioning to a groundwater monitoring only program (until downgradient VOC concentrations are comparable to the upgradient VOC concentrations).

Actual field results for the treatment may vary from the theoretical expectations due to:

- Subsurface heterogeneities and potential preferential pathways, which results in the inhibited distribution of the electron donor substrate. (This is an inherent issue associated with in-situ remedial technologies that rely on injection and distribution of amendments in the subsurface[46]); and
- Existing Site limitations on injection locations due to the substantial presence of underground utilities and other Site features (e.g., stairways, signs, and lighting) in the planned injection area may also limit effectiveness of the injection program because the reagents may not be dispersed to targeted areas where injections are not possible due to the presence of utilities or Site features.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

The work planned at the Site will comply with the standards specified in the MEW Unified Quality Assurance Project Plan (QAPP), except that EPA has requested that QA/QC samples for VOCs be collected for every 10 samples rather than the 20 samples specified in the QAPP. The project roles provided for in the QAPP will be performed by the following PES personnel:

- The project manager will be Ms. Susan Gahry, P.E., Principal Engineer with PES, who has worked on this Site for over 20 years. She will oversee and coordinate the work required in this work plan and will coordinate communication with EPA;
- The technical review will be provided by Mr. Scott Morrison, P.E., Associate Engineer. Mr. Morrison is a civil engineer who has worked on this Site since 2010;
- The task manager will be Mr. Gary Thomas, P.G., Associate Geologist with PES. Mr. Thomas will supervise the field work and will interact with the drillers to confirm actual injection locations and assist Ms. Gahry with oversight of the field activities; and
- The quality assurance role will be provided by Dr, Wenqian Dou, P.E., Associate Engineer, who has overseen quality assurance programs at another EPA site.

The analytical methods that will be utilized during this project are summarized in Table 3.

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[46] ITRC, 2008. *Technical/Regulatory Guidance, In-Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones*. June.

QA/QC samples for VOC analyses will be collected from groundwater samples. In accordance with the MEW QAPP, one duplicate, one field blank and one equipment blank will be collected for every 10 samples collected for VOC analysis. In addition, a laboratory provided trip blank will be included with each cooler sent to the laboratory that contains groundwater samples for VOC analysis.

Field instrument, testing, inspection, and maintenance will be performed in accordance with manufacturer guidance. With regard to data validation, the following will be reviewed for samples submitted for laboratory analysis: holding times, instrument calibration, laboratory blanks, surrogates, matrix spike/matrix spike duplicates, and internal standards. Data qualifiers will be assigned to sample results, as needed.

6.0 CONTINGENCY PLAN

The following condition may trigger a contingency measure, which is discussed in detail in Appendix F:

- If, during post-injection monitoring, increased TCE concentrations in groundwater (increase substantially above baseline concentrations) in groundwater monitoring wells near the treatment area are detected, the contingency measure will be implemented; and

- If, during post-injection monitoring, elevated levels of chlorinated VOCs in soil vapor are detected, contingency measures will be implemented,

7.0 IMPLEMENTATION SCHEDULE

As discussed earlier, the injection activities are planned in July 2019, subject to EPA's approval of this work plan, obtaining a reasonable access agreement with the property owner, and subcontractor availability (RRS is currently reserved for July 2019). Permits for the new monitoring wells have been obtained. Pathway sealing and baseline indoor air sampling within 455 EMR and 485/487 EMR will be completed as soon as the property owner allows. Site underground utility locating has been completed (including meeting with the fiber optic contractor). As soon as an access agreement is signed or the property owner allows completion work, the following activities will be completed:

- Complete air-knifing or-hand augering to depth of 5 feet bgs at the locations of the new monitoring wells, and proposed injection locations. If completed more than a few days in advance of the injections, backfill the boreholes with hydrated bentonite to surface and refill if needed if the surface recedes;

- Install, develop, survey, and complete baseline monitoring of the five new groundwater monitoring wells and other Site monitoring wells;

- Install and complete baseline monitoring of the four new soil vapor probes;

- If timing allows, review the baseline monitoring results to assess whether the AquaZVI™ injection plan is appropriate and, make modifications, if necessary (with EPA approval); and

- Complete air-knifing or hand-augering to depth of 5 feet bgs if any injection locations are modified.

The injection activities will be completed as soon as feasible (subject to subcontractor availability) after the property owner grants Site access for the proposed work. Currently, RRS is scheduled to perform the proposed injection activities in July 2019 (commencing on July 8 and ending before July 26). Site restoration activities will be completed the last week of July.

Post injection monitoring and reporting will be completed for up to two years after the injections. The first post injection groundwater monitoring event will be completed approximately one month after the injections are completed. The 2019 fall/winter post injection monitoring event will coincide with the 2019 annual monitoring event.

TABLES

Table 1
Groundwater Concentrations
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
C-2	A	31-Aug-1989	**48**	NT	
C-2	A	27-Feb-1992	**21**	**34**	
C-2	A	25-Sep-1992	< 1	< 1	
C-2	A	26-Jun-1995	**61**	< 1	
C-2	A	13-Mar-1996	**25**	< 1	
C-2	A	13-Mar-1996	**25**	< 0.5	
C-2	A	16-Dec-1997	**15**	< 0.5	
C-2	A	18-Dec-1998	**7.3**	< 0.5	
C-2	A	7-Dec-1999	**7.1**	**1.4**	
C-2	A	19-Dec-2000	**3.5**	< 0.5	
C-2	A	18-Dec-2002	**4.1**	< 0.5	
C-2	A	21-Dec-2004	**5.4**	< 0.5	
C-2	A	20-Dec-2006	**1.8**	< 0.5	
C-2	A	17-Dec-2008	**4.0**	< 0.5	
C-2	A	14-Dec-2010	**3.3**	< 0.5	
C-2	A	1-Oct-2012	**3.8**	< 0.5	
C-2	A	6-Nov-2014	**4.2**	< 0.5	
C-2	A	14-Oct-2016	**4.3**	< 0.5	
C-2	A	25-Oct-2017	**2.3**	< 0.5	
C-3	A	5-Sep-1989	**52**	NT	
C-3	A	27-Feb-1992	**37**	< 1	
C-3	A	28-Jun-1995	**740**	< 1	
C-3	A	17-Jan-1996	**480**	< 10	
C-3	A	13-Mar-1996	**480**	< 10	
C-3	A	13-Mar-1996	**400**	< 10	
C-3	A	25-Jun-1997	**380**	< 5	
C-3	A	24-Sep-1997	**400**	< 5	
C-3	A	16-Dec-1997	**290**	< 5	
C-3	A	16-Mar-1998	**270**	< 5	
C-3	A	4-Jan-1999	**230**	< 5	
C-3	A	17-Jun-1999	**310**	< 5	
C-3	A	7-Dec-1999	**260**	**6.1**	
C-3	A	19-Dec-2000	**110**	< 2.5	
C-3	A	12-Dec-2001	**320**	< 5	
C-3	A	18-Dec-2002	**310**	< 5	
C-3	A	22-Dec-2003	**360**	**4.7**	
C-3	A	22-Dec-2004	**240**	< 2.5	
C-3	A	14-Dec-2005	**420**	**5.0**	
C-3	A	21-Dec-2006	**140**	**1.9**	
C-3	A	19-Dec-2007	**240**	**2.7**	
C-3	A	17-Dec-2008	**240**	**<2.5**	
C-3	A	17-Dec-2009	**400**	**5.9**	DUP: TCE = 420; cis-1,2-DCE = 6.1.
C-3	A	14-Dec-2010	**580**	**8.4**	
C-3	A	25-Oct-2011	**260**	**2.8**	
C-3	A	1-Oct-2012	**490**	**7.1**	
C-3	A	3-Oct-2013	**250**	**2.9**	DUP: TCE = 240; cis-1,2-DCE = 2.7.
C-3	A	2-May-2014	**760**	**110**	1,1-DCA = 3.4; VC = 10; nitrate = 6.4 mg/L; sulfate = 89 mg/L.
C-3	A	6-Nov-2014	**140**	**3.4**	
C-3	A	14-Oct-2016	**64**	**1.7**	Nitrate = 16 mg/L; sulfate =110 mg/L. DUP: TCE =64; cis-1,2-DCE = 1.7.
C-3	A	25-Oct-2017	**170**	**3.0**	Nitrate = 30 mg/L; sulfate = 97 mg/L; nitrite = 2.7 mg/L; manganese = 0.033 mg/L.
C-3	A	8-Nov-2018	**100**	**2.1**	
IM-7A	A	12-Feb-1986	**17**	NT	
IM-7A	A	25-Mar-1986	**480**	NT	
IM-7A	A	26-Mar-1986	**400**	NT	
IM-7A	A	1-Apr-1986	**420**	NT	
IM-7A	A	17-Oct-1986	**430**	NT	
IM-7A	A	19-Nov-1992	**180**	< 50	
IM-7A	A	28-Jun-1995	**200**	< 4	
IM-7A	A	17-Jan-1996	**140**	< 2.5	
IM-7A	A	13-Mar-1996	**120**	< 2.5	
IM-7A	A	25-Jun-1997	**67**	< 1	
IM-7A	A	24-Sep-1997	**73**	< 2.5	
IM-7A	A	15-Dec-1997	**56**	< 2.5	
IM-7A	A	17-Mar-1998	**54**	< 2.5	
IM-7A	A	16-Jun-1999	**36**	< 0.5	
IM-7A	A	7-Dec-1999	**6.8**	< 0.5	
IM-7A	A	19-Dec-2000	**36**	< 0.5	
IM-7A	A	12-Dec-2001	**31**	< 0.5	
IM-7A	A	18-Dec-2002	**13**	< 0.5	
IM-7A	A	22-Dec-2003	**8.9**	< 0.5	
IM-7A	A	22-Dec-2004	**15**	< 0.5	
IM-7A	A	14-Dec-2005	**16**	< 0.5	
IM-7A	A	20-Dec-2006	**7.5**	< 0.5	
IM-7A	A	19-Dec-2007	**11**	< 0.5	
IM-7A	A	17-Dec-2008	**11**	< 0.5	
IM-7A	A	17-Dec-2009	**12**	< 0.5	
IM-7A	A	14-Dec-2010	**12**	< 0.5	
IM-7A	A	25-Oct-2011	**11**	**0.80**	
IM-7A	A	1-Oct-2012	**9.4**	< 0.5	
IM-7A	A	3-Oct-2013	**14**	< 0.5	
IM-7A	A	6-Nov-2014	**4.6**	< 0.5	
IM-7A	A	14-Oct-2016	**11**	< 0.5	
IM-7A	A	25-Oct-2017	**4.6**	< 0.5	
IM-7A	A	8-Nov-2018	**8.8**	< 0.5	

Table 1
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Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
ME-1A	A	29-May-1985	80	3.0	
ME-1A	A	19-Jun-1985	45	NT	
ME-1A	A	12-Jul-1985	49	NT	
ME-1A	A	12-Jul-1985	81	NT	
ME-1A	A	19-Sep-1985	14	NT	
ME-1A	A	26-Nov-1985	62	NT	
ME-1A	A	26-Nov-1985	47	NT	
ME-1A	A	14-Oct-1986	41	NT	
ME-1A	A	25-Sep-1992	36	9.1	
ME-1A	A	28-Jun-1995	31	10	
ME-1A	A	17-Nov-1995	29	8.8	
ME-1A	A	20-Dec-1995	22	8.0	
ME-1A	A	17-Jan-1996	3.6	2.2	
ME-1A	A	13-Mar-1996	19	6.3	
ME-1A	A	25-Jun-1997	39	7.7	
ME-1A	A	24-Sep-1997	51	9.2	
ME-1A	A	15-Dec-1997	85	15	
ME-1A	A	18-Dec-1998	75	6.0	
ME-1A	A	7-Dec-1999	150	14	
ME-1A	A	19-Dec-2000	200	13	
ME-1A	A	18-Dec-2002	170	15	
ME-1A	A	22-Dec-2003	140	14	DUP: TCE = 160; cis-1,2-DCE = 15.
ME-1A	A	22-Dec-2004	120	13	
ME-1A	A	14-Dec-2005	66	6.8	
ME-1A	A	21-Dec-2006	57	8.2	
ME-1A	A	19-Dec-2007	98	8.2	
ME-1A	A	17-Dec-2008	90	11	PCE = 0.54; 1,1-DCA = 0.53. DUP: TCE = 89; cis-1,2-DCE = 12.
ME-1A	A	17-Dec-2009	78	9.9	
ME-1A	A	14-Dec-2010	67	9.0	DUP: TCE = 67; cis-1,2-DCE = 8.8.
ME-1A	A	25-Oct-2011	55	6.4	Freon 113 = 0.53.
ME-1A	A	1-Oct-2012	79	10	
ME-1A	A	3-Oct-2013	52	7.2	Freon 113 = 0.50.
ME-1A	A	6-Nov-2014	70	9.3	
ME-1A	A	14-Oct-2016	45	5.5	
ME-1A	A	25-Oct-2017	43	4.9	
R-15A	A	2-Mar-1985	3,100	NT	
R-15A	A	15-Mar-1985	3,700	NT	
R-15A	A	22-Apr-1985	2,700	NT	
R-15A	A	7-Jun-1985	2,900	NT	
R-15A	A	12-Sep-1985	2,200	NT	
R-15A	A	27-Jan-1985	2,900	NT	
R-15A	A	6-Mar-1986	2,900	NT	
R-15A	A	22-Oct-1986	1,800	NT	
R-15A	A	16-Oct-1992	410	< 10	
R-15A	A	26-Jun-1995	370	< 1	
R-15A	A	17-Nov-1995	400	< 6	
R-15A	A	20-Dec-1995	470	< 1	
R-15A	A	17-Jan-1996	400	< 5	
R-15A	A	11-Mar-1996	540	< 10	
R-15A	A	15-Dec-1997	220	< 25	
R-15A	A	16-Mar-1998	270	< 5	
R-15A	A	4-Jan-1999	190	< 2.5	
R-15A	A	16-Jun-1999	240	< 0.5	
R-15A	A	8-Dec-1999	140	< 0.5	
R-15A	A	19-Dec-2000	17	< 0.5	
R-15A	A	12-Dec-2001	110	< 2.5	
R-15A	A	18-Dec-2002	39	< 0.5	
R-15A	A	22-Dec-2003	70	< 0.5	
R-15A	A	21-Dec-2004	100	< 1	
R-15A	A	14-Dec-2005	67	< 0.5	
R-15A	A	21-Dec-2006	44	< 0.5	
R-15A	A	19-Dec-2007	67	0.54	
R-15A	A	17-Dec-2008	65	0.78	
R-15A	A	17-Dec-2009	56	0.55	
R-15A	A	14-Dec-2010	44	< 0.5	
R-15A	A	25-Oct-2011	78	0.50	PCE = 0.69.
R-15A	A	1-Oct-2012	18	< 0.5	
R-15A	A	3-Oct-2013	67	0.54	PCE = 0.64.
R-15A	A	6-Nov-2014	47	0.77	
R-15A	A	14-Oct-2016	82	3.9	
R-15A	A	25-Oct-2017	66	1.3	PCE = 0.52.
R-15A	A	8-Nov-2018	52	1.1	PCE = 0.54; Chloroform = 0.54.
R-20A	A	5-May-1985	68	NT	
R-20A	A	30-May-1985	30	NT	
R-20A	A	12-Sep-1985	90	NT	
R-20A	A	19-Sep-1985	44	NT	
R-20A	A	23-Dec-1985	38	NT	
R-20A	A	4-Mar-1986	120	NT	
R-20A	A	9-Oct-1986	49	NT	
R-20A	A	25-Sep-1989	143	NT	
R-20A	A	26-Jun-1995	89	4.4	
R-20A	A	17-Jan-1996	280	NT	
R-20A	A	13-Mar-1996	350	9.4	
R-20A	A	16-Dec-1997	290	NT	
R-20A	A	18-Dec-1998	220	16	
R-20A	A	8-Dec-1999	180	30	
R-20A	A	19-Dec-2000	180	25	
R-20A	A	18-Dec-2002	190	8.5	
R-20A	A	22-Dec-2003	340	15	
R-20A	A	22-Dec-2004	360	15	

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Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
R-20A	A	21-Dec-2006	**360**	**11**	
R-20A	A	2-Feb-2009	**320**	**8.1**	Well resampled on Feb. 2, 2009.
R-20A	A	14-Dec-2010	**480**	**14**	
R-20A	A	1-Oct-2012	**580**	**14**	
R-20A	A	2-May-2014	**240 / 250**	**6.9 / 7.4**	Nitrate = 16 mg/L; sulfate = 82 mg/L.
R-20A	A	6-Nov-2014	**60 / 57**	**2.5 / 2.2**	VC = 0.50 and <0.50.
R-20A	A	14-Oct-2016	**560**	**38**	VC = 15; trans-1,2-DCE = 0.62; 1,1-DCA = 1.5; 1,1-DCE = 0.94.
R-20A	A	8-Feb-2017	**660**	**19**	DUP: TCE = 570; cis-1,2-DCE = 16.
R-20A	A	25-Oct-2017	**590**	**12**	Nitrate = 7.4 mg/L; sulfate = 93 mg/L; nitrite = 2.8 mg/L. DUP: TCE = 670; cis-1,2-DCE = 14.
R-20A	A	8-Nov-2018	**650**	**22**	DUP: TCE = 610; cis-1,2-DCE = 19
R-21A	A	15-Aug-1985	**540**	NT	
R-21A	A	13-Sep-1985	**350**	NT	
R-21A	A	2-Dec-1985	**380**	NT	
R-21A	A	22-Oct-1986	**380**	NT	
R-21A	A	27-Jun-1989	**500**	< 5	
R-21A	A	31-Aug-1989	**68**	NT	
R-21A	A	25-Sep-1989	**397**	NT	
R-21A	A	9-Mar-1992	**1,400**	< 25	
R-21A	A	1-Dec-1992	**190**	< 10	
R-21A	A	28-Jun-1995	**110**	< 2	
R-21A	A	11-Mar-1996	**90**	**1.5**	
R-21A	A	25-Jun-1997	**60**	< 10	
R-21A	A	24-Sep-1997	**64**	< 2.5	
R-21A	A	16-Dec-1997	**45**	< 1.3	
R-21A	A	16-Mar-1998	**67**	< 0.5	
R-21A	A	16-Jun-1999	**63**	< 0.5	
R-21A	A	7-Dec-1999	**43**	**1.4**	
R-21A	A	19-Dec-2000	**43**	**1.3**	
R-21A	A	12-Dec-2001	**43**	**1.6**	
R-21A	A	18-Dec-2002	**37**	**1.4**	
R-21A	A	22-Dec-2003	**42**	**2.3**	
R-21A	A	21-Dec-2004	**39**	**2.3**	
R-21A	A	14-Dec-2005	**39**	**1.9**	
R-21A	A	20-Dec-2006	**40**	**2.4**	
R-21A	A	19-Dec-2007	**39**	**2.8**	
R-21A	A	17-Dec-2008	**47**	**4.8**	PCE = 0.59.
R-21A	A	17-Dec-2009	**44**	**4.6**	
R-21A	A	14-Dec-2010	**39**	**6.4**	
R-21A	A	25-Oct-2011	**57**	**7.4**	
R-21A	A	1-Oct-2012	**45**	**5.1**	
R-21A	A	3-Oct-2013	**41**	**5.1**	
R-21A	A	6-Nov-2014	**26**	**4.1**	
R-21A	A	14-Oct-2016	**27**	**5.5**	
R-21A	A	25-Oct-2017	**25**	**4.6**	
R-21A	A	8-Nov-2018	**24**	**5.4**	
R-48A	A	15-Dec-1986	< 1	NT	
R-48A	A	27-Jan-1987	**79**	NT	
R-48A	A	3-Feb-1987	**34**	NT	
R-48A	A	9-Mar-1992	**54**	< 1	
R-48A	A	13-Oct-1992	**6.8**	< 1	
R-48A	A	28-Jun-1995	**30**	< 1	
R-48A	A	11-Mar-1996	**17**	< 0.5	
R-48A	A	16-Dec-1997	**13**	< 0.5	
R-48A	A	19-Dec-2000	**10**	< 0.5	
R-48A	A	18-Dec-2002	**10**	< 0.5	
R-48A	A	21-Dec-2004	**7.0**	< 0.5	
R-48A	A	20-Dec-2006	**5.4**	< 0.5	
R-48A	A	17-Dec-2008	**8.5**	< 0.5	
R-48A	A	14-Dec-2010	**6.0**	< 0.5	
R-48A	A	1-Oct-2012	**6.9**	< 0.5	
R-48A	A	6-Nov-2014	**4.6**	< 0.5	
R-48A	A	14-Oct-2016	**5.5**	< 0.5	
R-48A	A	25-Oct-2017	**3.6**	< 0.5	
R-48A	A	8-Nov-2018	**3.6**	< 0.5	
R-51A	A	29-Apr-1987	**54**	NT	
R-51A	A	7-May-1987	**56**	NT	
R-51A	A	14-May-1987	**120**	NT	
R-51A	A	26-Jun-1995	**140**	< 1	
R-51A	A	17-Nov-1995	**130**	< 1	
R-51A	A	20-Dec-1995	**130**	< 1	
R-51A	A	17-Jan-1996	**120**	< 2.5	
R-51A	A	11-Mar-1996	**110**	< 2.5	
R-51A	A	16-Dec-1997	**65**	< 2.5	
R-51A	A	17-Dec-1998	**42**	< 0.5	
R-51A	A	7-Dec-1999	**40**	< 0.5	
R-51A	A	19-Dec-2000	**29**	< 0.5	
R-51A	A	18-Dec-2002	**27**	< 0.5	
R-51A	A	21-Dec-2004	**20**	< 0.5	
R-51A	A	20-Dec-2006	**15**	< 0.5	
R-51A	A	17-Dec-2008	**17**	< 0.5	
R-51A	A	14-Dec-2010	**14**	< 0.5	
R-51A	A	1-Oct-2012	**12**	< 0.5	
R-51A	A	6-Nov-2014	**11**	< 0.5	
R-51A	A	14-Oct-2016	**14**	< 0.5	
R-51A	A	25-Oct-2017	**9.3**	< 0.5	

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Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
SO-1	A	5-Sep-1989	**132**	NT	
SO-1	A	27-Feb-1992	**390**	< 1	
SO-1	A	25-Sep-1992	**260**	< 1	
SO-1	A	28-Jun-1995	**83**	< 1	
SO-1	A	17-Nov-1995	**57**	< 1	
SO-1	A	20-Dec-1995	**54**	< 1	
SO-1	A	18-Jan-1996	**53**	< 1	
SO-1	A	11-Mar-1996	**57**	< 1	
SO-1	A	16-Dec-1997	**33**	< 3.3	
SO-1	A	16-Dec-1998	**33**	< 0.5	
SO-1	A	7-Dec-1999	**36**	< 0.5	
SO-1	A	19-Dec-2000	**28**	< 0.5	
SO-1	A	18-Dec-2002	**30**	**0.56**	
SO-1	A	21-Dec-2004	**22**	**0.67**	
SO-1	A	20-Dec-2006	**19**	**0.89**	
SO-1	A	17-Dec-2008	**22**	**1.1**	
SO-1	A	14-Dec-2010	**15**	**0.71**	
SO-1	A	1-Oct-2012	**18**	**1.1**	
SO-1	A	6-Nov-2014	**16**	**0.92**	
SO-1	A	14-Oct-2016	**16**	**1.1**	
SO-1	A	25-Oct-2017	**12**	**0.84**	
SO-1	A	8-Nov-2018	**15**	**1.0**	
SO-2	A	31-Aug-1989	**67**	NT	
SO-2	A	25-Sep-1989	**41,000**	NT	
SO-2	A	25-Sep-1989	**36,600**	NT	
SO-2	A	12-Oct-1989	**35,000**	NT	
SO-2	A	27-Feb-1992	**60,000**	< 1	
SO-2	A	25-Sep-1992	**49,000**	< 1	
SO-2	A	28-Jun-1995	**230**	< 4	
SO-2	A	11-Oct-1995	**270**	**3.1**	
SO-2	A	17-Nov-1995	**280**	< 4	
SO-2	A	20-Dec-1995	**250**	**3.3**	
SO-2	A	18-Jan-1996	**170**	**4.7**	
SO-2	A	11-Mar-1996	**240**	**6.1**	
SO-2	A	15-Dec-1997	**93**	**3.2**	
SO-2	A	17-Dec-1998	**110**	**1.6**	
SO-2	A	7-Dec-1999	**95**	< 0.5	
SO-2	A	19-Dec-2000	**100**	**3.9**	
SO-2	A	18-Dec-2002	**45**	**1.7**	
SO-2	A	22-Dec-2003	**60**	**3.1**	
SO-2	A	21-Dec-2004	**66**	**3.4**	
SO-2	A	21-Dec-2006	**51**	**5.3**	1,1-DCA = 0.51.
SO-2	A	17-Dec-2008	**54**	**2.2**	1,1-DCA = 0.52.
SO-2	A	14-Dec-2010	**46**	**2.5**	1,1-DCA = 0.72.
SO-2	A	1-Oct-2012	**43**	**2.2**	
SO-2	A	6-Nov-2014	**24**	**0.60**	
SO-2	A	14-Oct-2016	**53**	**2.0**	
SO-2	A	25-Oct-2017	**48**	**1.3**	
SO-2	A	8-Nov-2018	**37**	**2.1**	
SO-PZ1	A	27-Apr-1993	**1,200**	< 25	
SO-PZ1	A	27-Apr-1993	**1,100**	< 25	
SO-PZ1	A	28-Jun-1995	**1,100**	< 15	
SO-PZ1	A	17-Nov-1995	**560**	<13	
SO-PZ1	A	20-Dec-1995	**450**	< 5	
SO-PZ1	A	17-Jan-1996	**520**	< 10	
SO-PZ1	A	13-Mar-1996	**560**	< 10	
SO-PZ1	A	25-Jun-1997	**450**	< 10	
SO-PZ1	A	25-Jun-1997	**470**	< 10	
SO-PZ1	A	24-Sep-1997	**920**	< 13	
SO-PZ1	A	15-Dec-1997	**350**	< 13	
SO-PZ1	A	15-Dec-1997	**340**	< 25	
SO-PZ1	A	16-Mar-1998	**570**	< 10	
SO-PZ1	A	4-Jan-1999	**340**	< 10	
SO-PZ1	A	16-Jun-1999	**360**	**63**	
SO-PZ1	A	7-Dec-1999	**400**	**830**	
SO-PZ1	A	19-Dec-2000	**10**	**310**	
SO-PZ1	A	12-Dec-2001	**130**	**690**	
SO-PZ1	A	18-Dec-2002	**84**	**610**	
SO-PZ1	A	22-Dec-2003	**110**	**570**	
SO-PZ1	A	22-Dec-2004	**160**	**620**	
SO-PZ1	A	14-Dec-2005	**66**	**380**	
SO-PZ1	A	21-Dec-2006	**13**	**78**	
SO-PZ1	A	19-Dec-2007	**12**	**370**	
SO-PZ1	A	17-Dec-2008	**100**	**200**	VC = 2.6
SO-PZ1	A	17-Dec-2009	**14**	**210**	
SO-PZ1	A	14-Dec-2010	**46**	**900**	VC = 24; trans-1,2-DCE = 3.9
SO-PZ1	A	25-Oct-2011	**120**	**310**	VC = 4.6. DUP: TCE = 130, cis-1,2-DCE = 300, VC = 3.9
SO-PZ1	A	1-Oct-2012	**130 / 120**	**820 / 800**	VC = 15/18; trans-1,2-DCE = 4.1/3.8; 1,1-DCE = 2.6/2.5; 1,1-DCA = <0.5/0.79
SO-PZ1	A	3-Oct-2013	**68**	**500**	VC = 69; trans-1,2-DCE = 3.2
SO-PZ1	A	6-Nov-2014	**33 / 31**	**180 / 170**	VC = 110 / 110
SO-PZ1	A	14-Oct-2016	< 2.5	**740**	VC = 66; trans-1,2-DCE = 4.7; sulfate = 130 mg/L
SO-PZ1	A	25-Oct-2017	**10**	**890**	VC = 110; sulfate = 120 mg/L; nitrite = 3.7 mg/L; manganese = 0.26 mg/L.
SO-PZ1	A	8-Nov-2018	**18**	**130**	trans-1,2-DCE = 1.7; VC = 110

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Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
SO-PZ2	A	27-Apr-1993	**3,900**	< 100	
SO-PZ2	A	28-Jun-1995	**5,000**	< 75	
SO-PZ2	A	17-Nov-1995	**7,400**	**85**	
SO-PZ2	A	17-Nov-1995	**5,900**	< 75	
SO-PZ2	A	20-Dec-1995	**1,900**	**120**	
SO-PZ2	A	20-Dec-1995	**1,800**	**120**	
SO-PZ2	A	17-Jan-1996	**4,200**	**280**	
SO-PZ2	A	17-Jan-1996	**4,000**	**240**	
SO-PZ2	A	12-Mar-1996	**1,200**	< 25	
SO-PZ2	A	12-Mar-1996	**1,400**	< 25	
SO-PZ2	A	25-Jun-1997	**3,500**	< 100	
SO-PZ2	A	24-Sep-1997	**6,300**	**110**	
SO-PZ2	A	24-Sep-1997	**7,000**	**110**	
SO-PZ2	A	15-Dec-1997	**8,000**	< 100	
SO-PZ2	A	16-Mar-1998	**700**	**150**	
SO-PZ2	A	16-Mar-1998	**2,900**	< 50	
SO-PZ2	A	4-Jan-1999	**2,400**	< 50	
SO-PZ2	A	16-Jun-1999	**2,900**	**730**	
SO-PZ2	A	8-Dec-1999	**800**	**2,500**	
SO-PZ2	A	19-Dec-2000	**190**	**270**	
SO-PZ2	A	12-Dec-2001	**610**	**3,600**	
SO-PZ2	A	18-Dec-2002	**120**	**1,900**	
SO-PZ2	A	22-Dec-2003	**35**	**370**	
SO-PZ2	A	22-Dec-2004	**230**	**960**	DUP: TCE = 160; cis-1,2-DCE = 290
SO-PZ2	A	14-Dec-2005	**510**	**2,200**	VC = 40. DUP: TCE = 43; cis-1,2-DCE = 2,300; VC = 43; trans-1,2-DCE = 23
SO-PZ2	A	21-Dec-2006	**420**	**1,500**	VC = 32. DUP: TCE = 410; cis-1,2-DCE = 1,600; VC = 30; trans-1,2-DCE = 20
SO-PZ2	A	19-Dec-2007	**38**	**840**	DUP: DCE = 160
SO-PZ2	A	17-Dec-2008	**420**	**1,500**	VC = 36; trans-1,2-DCE = 16
SO-PZ2	A	17-Dec-2009	**300**	**1,700**	VC = 46; trans-1,2-DCE = 19
SO-PZ2	A	14-Dec-2010	**21**	**430**	VC = 15. DUP: TCE = 18; cis-1,2-DCE = 370; VC = 19
SO-PZ2	A	25-Oct-2011	**350**	**1,200**	VC = 39; trans-1,2-DCE = 14
SO-PZ2	A	1-Oct-2012	**110**	**780**	VC = 30; trans-1,2-DCE = 11
SO-PZ2	A	3-Oct-2013	**52**	**640**	VC = 40
SO-PZ2	A	6-Nov-2014	**140**	**1,100**	VC = 32
SO-PZ2	A	14-Oct-2016	**24**	**340**	VC = 32 DUP: TCE =22, cis-1,2-DCE =310; trans-1,2-DCE = 6.2; VC =31.
SO-PZ2	A	25-Oct-2017	**1.2**	**49**	VC = 2.1; trans-1,2-DCE = 0.98; toluene = 0.50; sulfate = 120 mg/L; nitrite = 3.7 mg/L; manganese = 5.3 mg/L. DUP: TCE = 0.95; cis-1,2-DCE = 42; VC = 1.7; trans-1,2-DCE = 0.64
SO-PZ2	A	8-Nov-2018	**210**	**580**	1,1-DCE = 3.4; trans-1,2-DCE = 12; VC = 99. DUP: TCE = 250; cis-1,2-DCE = 650; 1,1-DCE = < 5.0; trans-1,2-DCE = 13; VC = 110.
SO-PZ3	A	27-Apr-1993	< 0.5	< 0.5	
SO-PZ3	A	16-Dec-1997	< 0.5	< 0.5	
SO-PZ3	A	17-Dec-1998	< 0.5	< 0.5	
SO-PZ3	A	8-Dec-1999	< 0.5	< 0.5	
SO-PZ3	A	19-Dec-2000	< 0.5	< 0.5	
SO-PZ3	A	18-Dec-2002	< 0.5	< 0.5	
SO-PZ3	A	21-Dec-2004	< 0.5	< 0.5	
SO-PZ3	A	20-Dec-2006	< 0.5	< 0.5	
SO-PZ3	A	17-Dec-2008	< 0.5	< 0.5	
SO-PZ3	A	14-Dec-2010	< 0.5	< 0.5	
SO-PZ3	A	1-Oct-2012	< 0.5	< 0.5	
SO-PZ3	A	6-Nov-2014	< 0.5	< 0.5	
SO-PZ3	A	14-Oct-2016	< 0.5	< 0.5	
SO-PZ3	A	25-Oct-2017	< 0.5	< 0.5	
SO-4	A	28-Jun-1995	**220**	< 4	
SO-4	A	28-Jun-1995	**210**	< 5	
SO-4	A	17-Jan-1996	**140**	< 2.5	
SO-4	A	13-Mar-1996	**140**	< 2.5	
SO-4	A	25-Jun-1997	**80**	< 1.2	
SO-4	A	24-Sep-1997	**81**	< 2.5	
SO-4	A	16-Dec-1997	**52**	< 2.5	
SO-4	A	16-Mar-1998	**51**	< 0.5	
SO-4	A	4-Jan-1999	**53**	< 1	
SO-4	A	16-Jun-1999	**58**	< 0.5	
SO-4	A	7-Dec-1999	**37**	< 0.5	
SO-4	A	19-Dec-2000	< 0.5	< 0.5	
SO-4	A	12-Dec-2001	**34**	< 0.5	
SO-4	A	18-Dec-2002	**28**	< 0.5	
SO-4	A	22-Dec-2003	**25**	< 0.5	
SO-4	A	21-Dec-2004	**19**	< 0.5	
SO-4	A	14-Dec-2005	**12**	< 0.5	
SO-4	A	20-Dec-2006	**6.1**	< 0.5	
SO-4	A	19-Dec-2007	**10**	< 0.5	
SO-4	A	17-Dec-2008	**18**	< 0.5	
SO-4	A	17-Dec-2009	**16**	< 0.5	
SO-4	A	14-Dec-2010	**14**	< 0.5	
SO-4	A	25-Oct-2011	**11**	< 0.5	
SO-4	A	1-Oct-2012	**14**	< 0.5	Chloroform = 4.0.
SO-4	A	3-Oct-2013	**15**	< 0.5	
SO-4	A	6-Nov-2014	**12**	< 0.5	
SO-4	A	14-Oct-2016	NT	NT	Insufficient water to sample.
SO-4	A	25-Oct-2017	NT	NT	Insufficient water to sample.
SO-4	A	8-Nov-2018	**8.0**	**1.3**	
EW-1	A	26-Jun-1995	**150**	< 2	
EW-1	A	17-Nov-1995	**76**	< 1	
EW-1	A	20-Dec-1995	**60**	< 1	
EW-1	A	17-Jan-1996	**51**	< 1	
EW-1	A	13-Mar-1996	**190**	< 2.5	
EW-1	A	25-Jun-1997	**180**	< 2.5	
EW-1	A	24-Sep-1997	**170**	< 5	
EW-1	A	17-Dec-1997	**170**	< 5	
EW-1	A	16-Mar-1998	**260**	< 2.5	

Table 1
Groundwater Concentrations
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
EW-1	A	4-Jan-1999	**200**	< 5	
EW-1	A	17-Jun-1999	**220**	< 0.5	
EW-1	A	8-Dec-1999	**140**	< 0.5	
EW-1	A	19-Dec-2000	**95**	< 2.5	
EW-1	A	12-Dec-2001	**77**	< 2.5	
EW-1	A	18-Dec-2002	**70**	< 2.5	
EW-1	A	22-Dec-2003	**78**	< 2.5	Chloroform = 0.58.
EW-1	A	22-Dec-2004	**46**	**1.1**	Chloroform = 0.61.
EW-1	A	14-Dec-2005	**75**	**1.2**	
EW-1	A	21-Dec-2006	**53**	**1.2**	
EW-1	A	19-Dec-2007	**53**	**1.6**	
EW-1	A	17-Dec-2008	**43**	< 0.5	
EW-1	A	17-Dec-2009	**56**	**1.6**	
EW-1	A	14-Dec-2010	**40**	< 0.5	
EW-1	A	25-Oct-2011	**56**	**0.93**	
EW-1	A	1-Oct-2012	**48**	**1.9**	
EW-1	A	3-Oct-2013	**67**	**3.8**	Dichlorobromomethane = 0.60.
EW-1	A	6-Nov-2014	**56**	**3.2**	
EW-1	A	14-Oct-2016	**69**	**2.4**	
EW-1	A	25-Oct-2017	**51**	**1.4**	
EW-1	A	8-Nov-2018	**59**	**5.7**	
EW-2	A	25-Jun-1997	**270**	< 5	
EW-2	A	24-Sep-1997	**220**	< 5	
EW-2	A	17-Dec-1997	**290**	< 5	
EW-2	A	16-Mar-1998	**290**	< 2.5	
EW-2	A	4-Jan-1999	**150**	< 5	
EW-2	A	15-Jun-1999	**190**	< 0.5	
EW-2	A	7-Dec-1999	**180**	< 0.5	
EW-2	A	19-Dec-2000	**140**	**3.2**	
EW-2	A	12-Dec-2001	**140**	**3.5**	
EW-2	A	18-Dec-2002	**88**	< 2.5	
EW-2	A	22-Dec-2003	**84**	**1.9**	Chloroform = 0.56.
EW-2	A	22-Dec-2004	**79**	**3.2**	Chloroform = 0.74.
EW-2	A	14-Dec-2005	**66**	**2.2**	
EW-2	A	21-Dec-2006	**59**	**3.3**	
EW-2	A	19-Dec-2007	**47**	**2.2**	
EW-2	A	17-Dec-2008	**92**	**5.6**	1,1,1-TCA = 0.51.
EW-2	A	6-Jan-2010	**81**	**6.7**	
EW-2	A	14-Dec-2010	**73**	**8.5**	
EW-2	A	4-Nov-2011	**55**	**13**	
EW-2	A	1-Oct-2012	**62**	**11**	
EW-2	A	3-Oct-2013	**110**	**32**	
EW-2	A	6-Nov-2014	**170**	**150**	
EW-2	A	14-Oct-2016	**91**	**59**	
EW-2	A	25-Oct-2017	**61**	**100**	trans-1,2-DCE = 0.81
EW-2	A	8-Nov-2018	**45**	**27**	
EW-3	A	25-Jun-1997	**220**	< 5	
EW-3	A	24-Sep-1997	**210**	< 5	
EW-3	A	17-Dec-1997	**170**	< 5	
EW-3	A	16-Mar-1998	**140**	< 2.5	
EW-3	A	4-Jan-1999	**130**	< 1	
EW-3	A	17-Jun-1999	**140**	< 0.5	
EW-3	A	7-Dec-1999	**92**	< 0.5	
EW-3	A	19-Dec-2000	**96**	< 2.5	
EW-3	A	12-Dec-2001	**86**	< 2.5	
EW-3	A	18-Dec-2002	**51**	< 0.5	
EW-3	A	22-Dec-2003	**47**	< 0.5	
EW-3	A	22-Dec-2004	**46**	< 0.5	Chloroform = 0.66.
EW-3	A	14-Dec-2005	**41**	< 0.5	
EW-3	A	21-Dec-2006	**32**	< 0.5	
EW-3	A	19-Dec-2007	**35**	< 0.5	
EW-3	A	17-Dec-2008	**43**	< 0.5	
EW-3	A	17-Dec-2009	**40**	< 0.5	
EW-3	A	14-Dec-2010	**41**	< 0.5	
EW-3	A	25-Oct-2011	**44**	< 0.5	
EW-3	A	1-Oct-2012	**45**	< 0.5	
EW-3	A	3-Oct-2013	**41**	< 0.5	
EW-3	A	6-Nov-2014	**50**	**0.51**	
EW-3	A	14-Oct-2016	**78**	**5.2**	
EW-3	A	25-Oct-2017	**50**	**1.3**	
EW-3	A	8-Nov-2018	**51**	**3.3**	
EW-4	A	25-Jun-1997	**130**	< 2.5	
EW-4	A	24-Sep-1997	**110**	< 2.5	
EW-4	A	17-Dec-1997	**69**	< 2.5	
EW-4	A	16-Mar-1998	**89**	< 0.5	
EW-4	A	4-Jan-1999	**69**	< 1	
EW-4	A	15-Jun-1999	**56**	< 0.5	
EW-4	A	7-Dec-1999	**60**	< 0.5	
EW-4	A	19-Dec-2000	**45**	< 1	
EW-4	A	12-Dec-2001	**49**	< 1	
EW-4	A	18-Dec-2002	**37**	< 1	
EW-4	A	22-Dec-2003	**34**	< 0.5	Chloroform = 0.51
EW-4	A	22-Dec-2004	**32**	< 0.5	Chloroform = 0.64
EW-4	A	14-Dec-2005	**31**	< 0.5	
EW-4	A	21-Dec-2006	**23**	< 0.5	
EW-4	A	19-Dec-2007	**28**	< 0.5	Sampled from port with pump off. Resampled March 18, 2008.
EW-4	A	17-Dec-2008	**34**	< 0.5	1,1,1-TCA = 0.53
EW-4	A	17-Dec-2009	**28**	< 0.5	
EW-4	A	14-Dec-2010	**27**	< 0.5	1,1,1-TCA = 0.51
EW-4	A	25-Oct-2011	**24**	< 0.5	

Table 1
Groundwater Concentrations
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

Well Number	Aquifer	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	Notes
EW-4	A	1-Oct-2012	**32**	**1.4**	
EW-4	A	3-Oct-2013	**27**	< 0.5	
EW-4	A	6-Nov-2014	**25**	< 0.5	
EW-4	A	14-Oct-2016	**59**	**0.53**	
EW-4	A	25-Oct-2017	**45**	**10**	Acetone = 23,000; MEK = 35,000. Resampled 12/21/2017: TCE = 30; Acetone = 27,000; MEK = 17,000. Resampled 1/19/2018: Acetone = 360; MEK = 570; TCE = 3.3. Acetone/MEK from glue.
EW-4	A	8-Nov-2018	**13**	< 0.5	
SO3-B1	B1	27-Feb-1992	**18**	**10**	
SO3-B1	B1	26-Jun-1995	**11**	**6.6**	
SO3-B1	B1	11-Mar-1996	**10**	**6.4**	
SO3-B1	B1	11-Mar-1996	**12**	**7.0**	
SO3-B1	B1	15-Dec-1997	**3.4**	**2.1**	
SO3-B1	B1	17-Dec-1998	**1.1**	< 0.5	
SO3-B1	B1	7-Dec-1999	**3.6**	< 0.5	
SO3-B1	B1	19-Dec-2000	**2.5**	< 0.5	
SO3-B1	B1	18-Dec-2002	**1.3**	< 0.5	
SO3-B1	B1	21-Dec-2004	**2.0**	**0.69**	
SO3-B1	B1	20-Dec-2006	< 0.5	< 0.5	
SO3-B1	B1	17-Dec-2008	< 0.5	< 0.5	
SO3-B1	B1	14-Dec-2010	**3.3**	**1.5**	
SO3-B1	B1	1-Oct-2012	< 0.5	< 0.5	
SO3-B1	B1	6-Nov-2014	< 0.5	< 0.5	
SO3-B1	B1	14-Oct-2016	< 0.5	< 0.5	
SO3-B1	B1	25-Oct-2017	< 0.5	< 0.5	

Notes:
µg/L = micrograms per liter (unless otherwise noted)
mg/L = milligrams per liter (i.e., sulfate and nitrate results).
NT = not tested.
PCE = tetrachloroethylene.
TCE = trichloroethylene.
cis-1,2-DCE = cis-1,2-dichloroethylene.
trans-1,2-DCE = trans-1,2-dichloroethylene.
VC = vinyl chloride.
1,1-DCE = 1,1-Dichloroethene.
1,1-DCA = 1,1-Dichloroethane.
1,1,1-TCA = 1,1,1-Trichloroethane.
MEK = 2-butanone.
RA = Indicates a Re-analysis of the sample.
< 5 = Not detected above specified detection limit.
Detections shown in bold.

Table 2
Geochemical Parameters
SMI Holding LLC
Mountain View, California

Well Identification	Sample Date	Dissolved Oxygen, mg/L	ORP, mV	Alkalinity, Bicarbonate (as $CaCO_3$), mg/L	Methane, mg/L	Carbon Dioxide, mg/L	Iron, mg/L	Manganese, mg/L	Nitrate, mg/L	Sulfate, mg/L
Furthest Downgradient (Off-Site Wells)										
ME-1A	12/22/2003	1.4	-4	NA	NA	NA	NA	NA	NA	NA
R-15A	12/22/2003	4.0	17	NA	NA	NA	NA	NA	NA	NA
Downgradient Site Boundary Wells										
C-3	**10/25/2017**	**9.1**	**364**	**NA**	**ND<0.050**	**NA**	**ND<1.0**	**0.033**	**30**	**97**
C-3	10/14/2016	3.90	118	NA	NA	NA	NA	NA	16	110
C-3	12/22/2003	1.2	-11	410	ND<0.010	31	<0.20	3.1	22	100
R-20A	**10/25/2017**	**4.36**	**104**		**ND<0.050**		**ND<1.0**	**ND<0.020**	**7.4**	**93**
R-20A	12/22/2003	2.7	-2	NA	NA	NA	NA	NA	NA	NA
Site Source Area Wells										
SO-PZ1	**10/25/2017**	**3.31**	**83**	**NA**	**200**	**NA**	**ND<1.0**	**0.26**	**ND<10**	**120**
SO-PZ1	10/14/2016	0.13	-122	NA	NA	NA	NA	NA	ND<1.0	130
SO-PZ1	12/22/2003	0.60	-43	NA	NA	NA	NA	NA	NA	NA
SO-PZ1	12/3/2002	1.1	33	NA	NA	NA	NA	NA	0 *	195
SO-PZ2	**10/25/2017**	**7.56**	**161**	**NA**	**4.4**	**NA**	**ND<1.0**	**5.3**	**ND<10**	**120**
SO-PZ2	10/14/2016	0.43	101	NA	NA	NA	NA	NA	ND<1.0	140
SO-PZ2	12/22/2003	0.30	-21	360	ND<0.010	34	36	0.96	ND<1.0	110
SO-PZ2	12/3/2002	1.0	184	NA	NA	NA	NA	NA	0 *	113

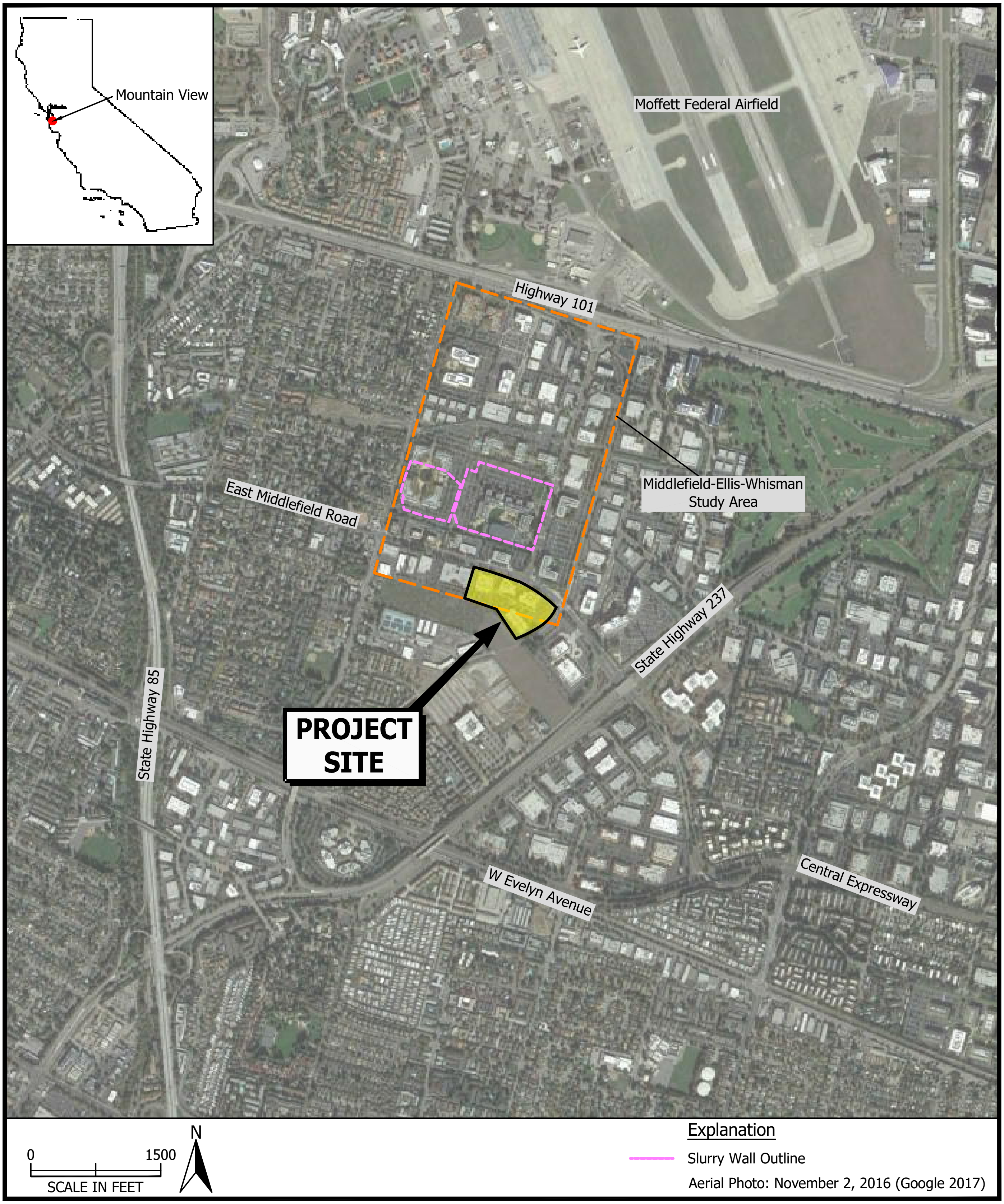
Notes:
* Data referenced from: Bioremediation Consulting Inc. 2003. *PES Environmental / Mountain View, CA Microcosm Study, Groundwater from Wells SOPZ-2, Sampled 12/3/02.* April 15.
1. ND = Not detected above the specified laboratory reporting limit.
2. NA = Not analyzed.
3. mg/L = milligrams per liter.
4. mV = millivolts.
5. ORP = Oxidation-reduction potential.
6. Dissolved oxygen and ORP measured in field with flow-through cell on 12/22/03, 10/14/2016, and 10/25/2017.
7. Dissolved oxygen and ORP measured in field during low-flow purge (flow-through cell not used) on 12/3/2002.
8. $CaCO_3$ = Calcium carbonate.

Table 3
Groundwater Monitoring Plan
SMI Holding LLC
Mountain View, California

Parameter	Analytical Method	Laboratory Reporting Limit	Laboratory
DO, ORP, pH, Conductivity, Turbidity Temperature	Field measurement with YSI Pro Plus water qulity meter	--	--
Ferrous Iron	Field measurement with Hach iron test kit	--	--
VOCs	EPA Method 8260B	Varies with compound (< 0.5 µg/L for most VOCs, unless VOCs are present in high concentrations and sample dilution is required)	TestAmerica
Nitrate (as nitrogen)	EPA Method 300.0	1 mg/L	TestAmerica
Sulfate	EPA Method 300.0	1 mg/L	TestAmerica
Ferric Iron	Method 3500	0.1 mg/L	TestAmerica
Carbon Dioxide	RSK-175	2.0 mg/L	TestAmerica
Dissolved Gases	AM20GAX	methane = 0.5 µg/L; ethane and ethene = 0.1 µg/L; acetylene = 0.5 µg/L	Pace Analytical

Notes:
1. VOCs = volatile organic compounds.
2. TestAmerica = Eurofins TestAmerica of Pleasanton, California.
3. Pace Analtyical = Pace Analytical Energy Services LLC of Pittsburgh, Pennsylvania (formerly Microseeps, Inc.).
4. mg/L = milligrams per liter.
5. -- = Not applicable.
6. µg/L = microrgram per liter.
7. EPA = U.S. Environmental Protection Agency
8. DO = dissolved oxygen
9. ORP = oxidation-reduction potential

ILLUSTRATIONS



Explanation

Slurry Wall Outline

Aerial Photo: November 2, 2016 (Google 2017)

PES Environmental, Inc.
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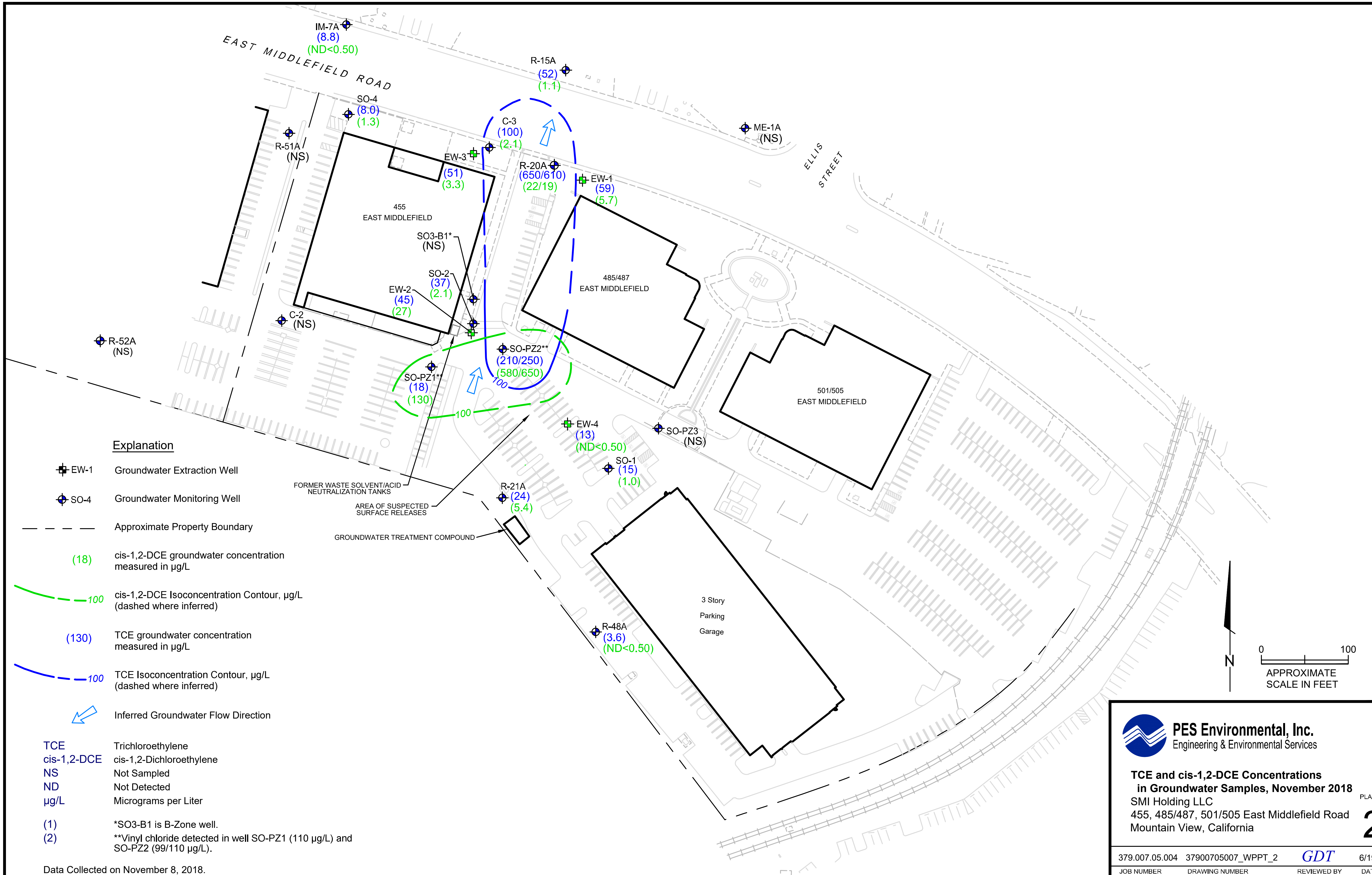
Site Location Map
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

PLATE
1

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.007	37900705007_WPPT_1	GDT	6/19



Explanation

EW-1	Groundwater Extraction Well
SO-4	Groundwater Monitoring Well
	Approximate Property Boundary
(18)	cis-1,2-DCE groundwater concentration measured in µg/L
100	cis-1,2-DCE Isoconcentration Contour, µg/L (dashed where inferred)
(130)	TCE groundwater concentration measured in µg/L
100	TCE Isoconcentration Contour, µg/L (dashed where inferred)
	Inferred Groundwater Flow Direction

TCE	Trichloroethylene
cis-1,2-DCE	cis-1,2-Dichloroethylene
NS	Not Sampled
ND	Not Detected
µg/L	Micrograms per Liter

(1) *SO3-B1 is B-Zone well.

(2) **Vinyl chloride detected in well SO-PZ1 (110 µg/L) and SO-PZ2 (99/110 µg/L).

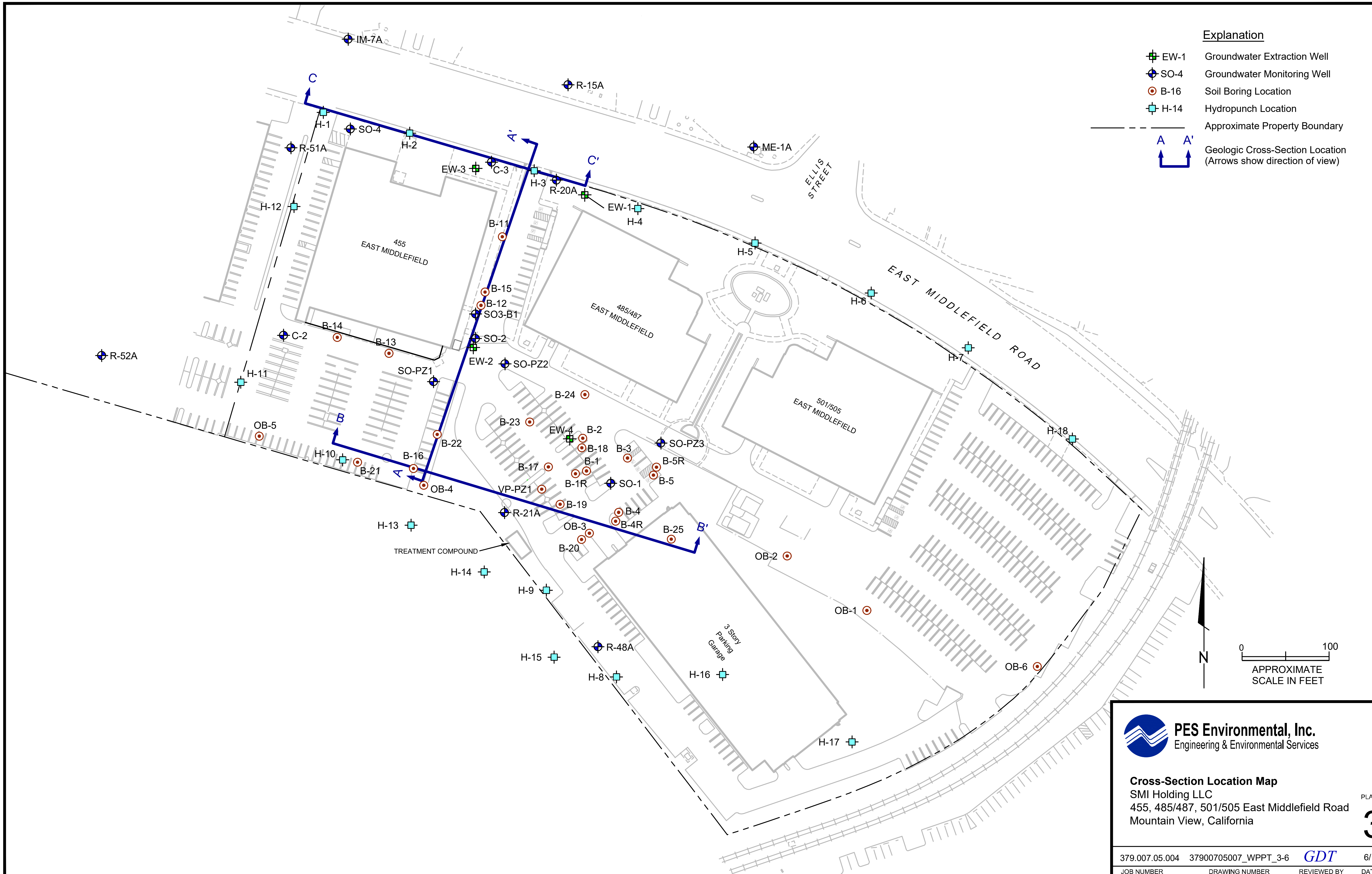
Data Collected on November 8, 2018.

PES Environmental, Inc.
Engineering & Environmental Services

TCE and cis-1,2-DCE Concentrations in Groundwater Samples, November 2018
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

PLATE 2

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.004	37900705007_WPPT_2	GDT	6/19

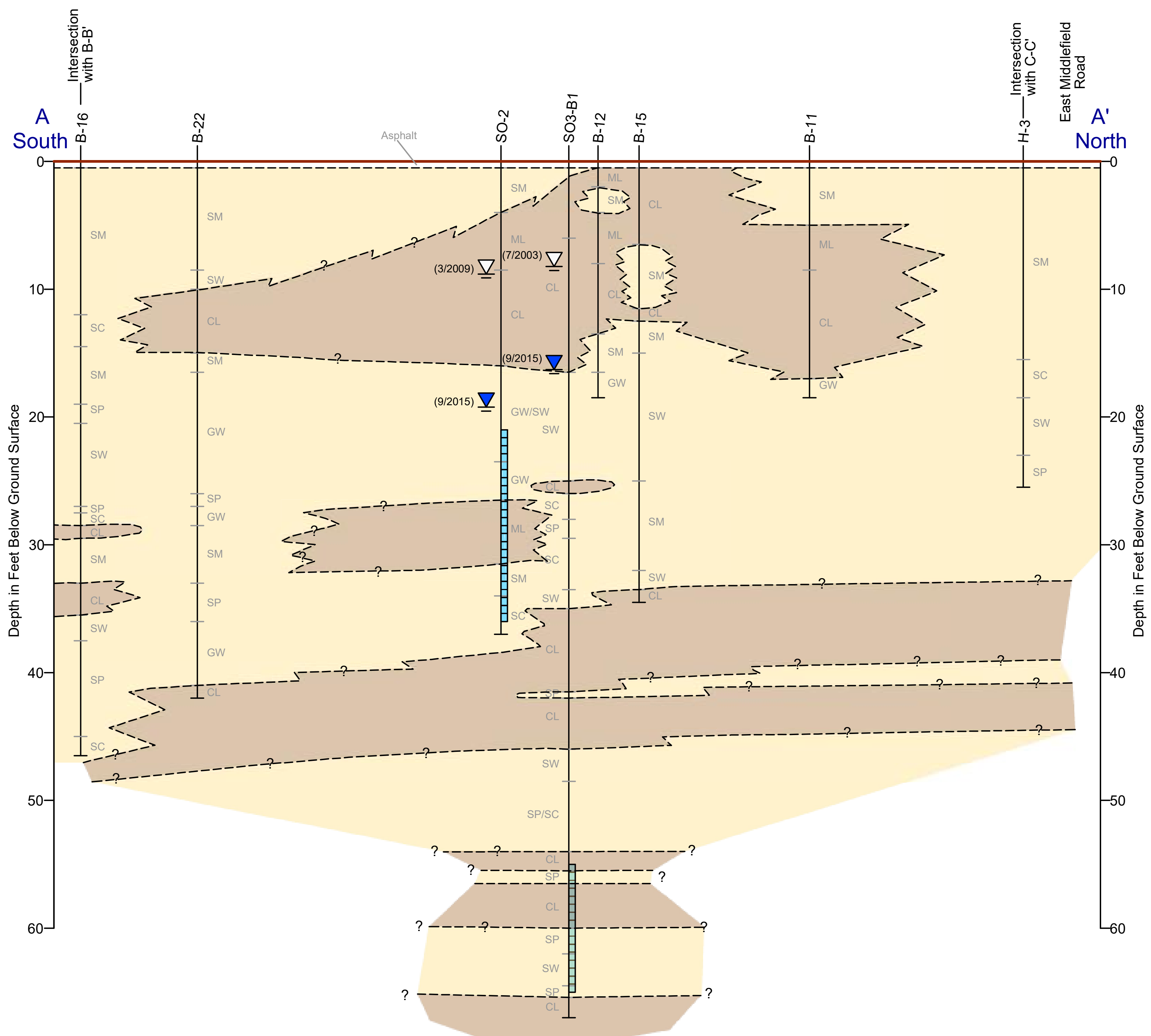


PES Environmental, Inc.
Engineering & Environmental Services

Cross-Section Location Map
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

PLATE
3

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.004	37900705007_WPPT_3-6	GDT	6/19



Explanation

Ground Surface

?- - - - - - -? Geologic Contact (Queried where Uncertain)

Soil Boring or Monitoring Well Location with lithologic contact

Well screen interval

Minimum depth-to-water (DTW)

Maximum DTW

Note: Data concerning the various strata have been obtained at exploration locations only. The soil stratigraphy between these locations has been inferred from geologic evidence and may vary.

	Soil Description based on Unified Soil Classification System
	Asphalt
Predominantly coarse-grained deposits	(GP) Poorly Graded Gravel (GW) Well-Graded Gravel (GM) Silty Gravel (GC) Clayey Gravel (SP) Poorly Graded Sand (SW) Well-Graded Sand (SM) Silty Sand (SC) Clayey Sand
Predominantly fine-grained deposits	(ML) Silt with or without sand and gravel (CL) Clay with or without sand and gravel

Vertical Scale in Feet (0–10)

Horizontal Scale in Feet (0–50)

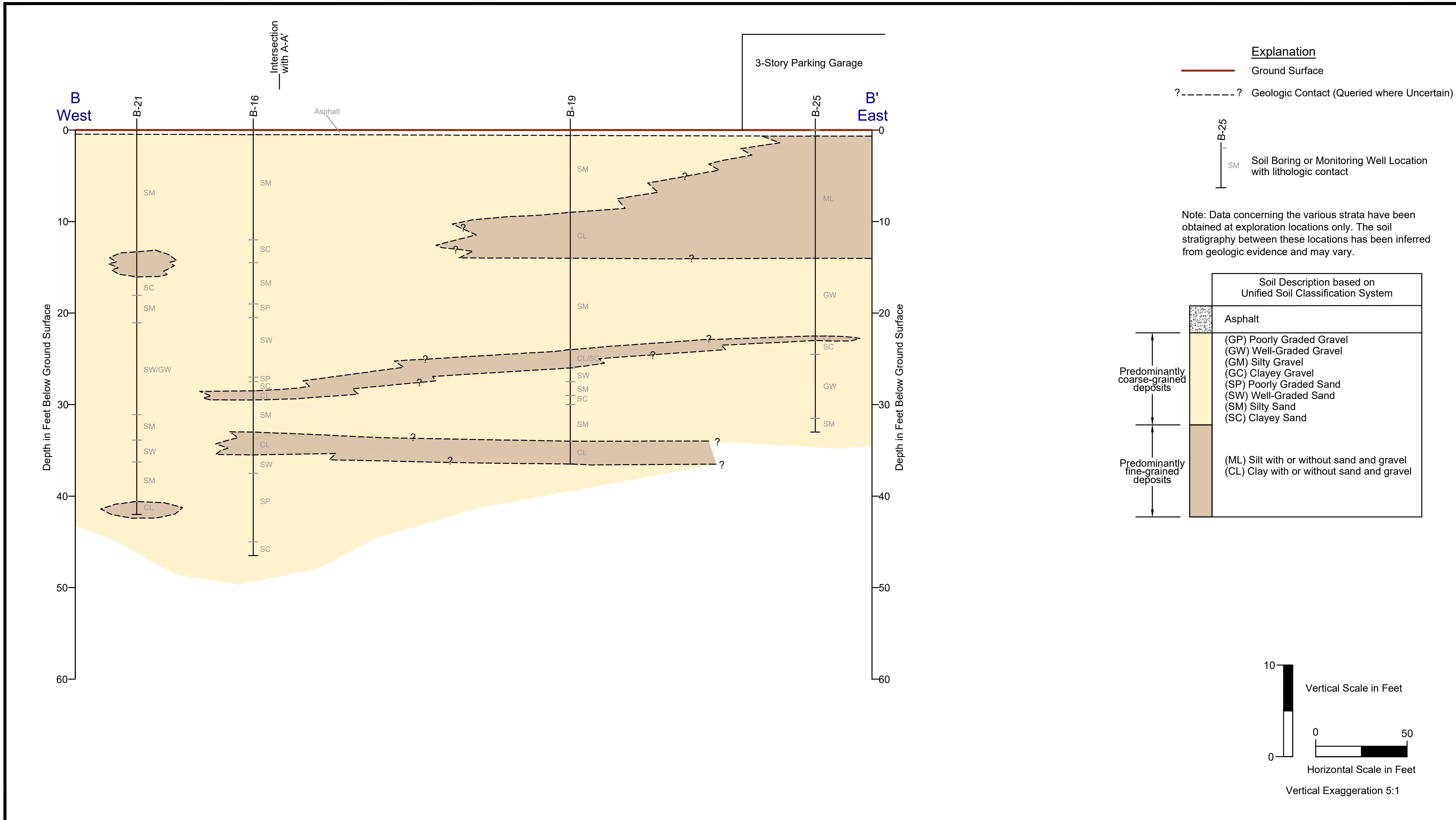
Vertical Exaggeration 5:1

PES Environmental, Inc.
Engineering & Environmental Services

Cross-Section A-A'
SMI Holding LLC
455, 486/487, 501/505 East Middlefield Road
Mountain View, California

PLATE 4

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.004	37900705007_WPPT_3-6	GDT	6/19

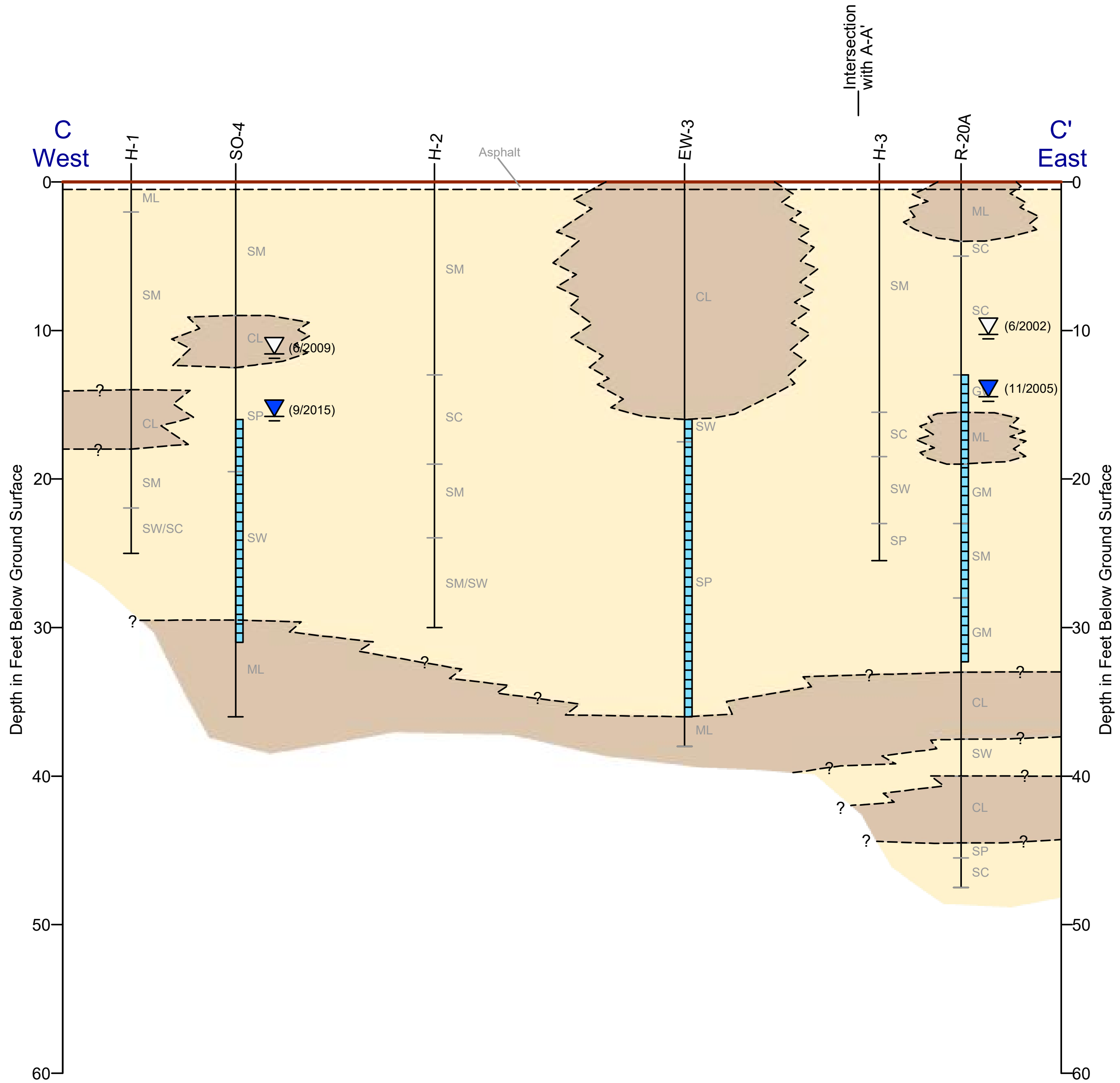


PES Environmental, Inc.
Engineering & Environmental Services

Cross-Section B-B'
SMI Holding LLC
455, 486/487, 501/505 East Middlefield Road
Mountain View, California

PLATE 5

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.004	37900705007_WPPT_3-6	GDT	6/19

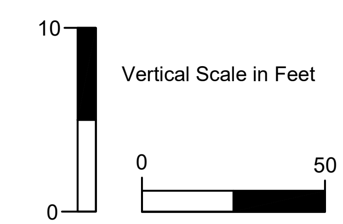


Explanation

- Ground Surface
- ?- - - - - -? Geologic Contact (Queried where Uncertain)
- H-3 / SM — Soil Boring or Monitoring Well Location with lithologic contact
- SO-4 — Well screen interval
- Minimum depth-to-water (DTW)
- Maximum DTW

Note: Data concerning the various strata have been obtained at exploration locations only. The soil stratigraphy between these locations has been inferred from geologic evidence and may vary.

	Soil Description based on Unified Soil Classification System
	Asphalt
Predominantly coarse-grained deposits	(GP) Poorly Graded Gravel (GW) Well-Graded Gravel (GM) Silty Gravel (GC) Clayey Gravel (SP) Poorly Graded Sand (SW) Well-Graded Sand (SM) Silty Sand (SC) Clayey Sand
Predominantly fine-grained deposits	(ML) Silt with or without sand and gravel (CL) Clay with or without sand and gravel



Vertical Exaggeration 5:1

PES Environmental, Inc.
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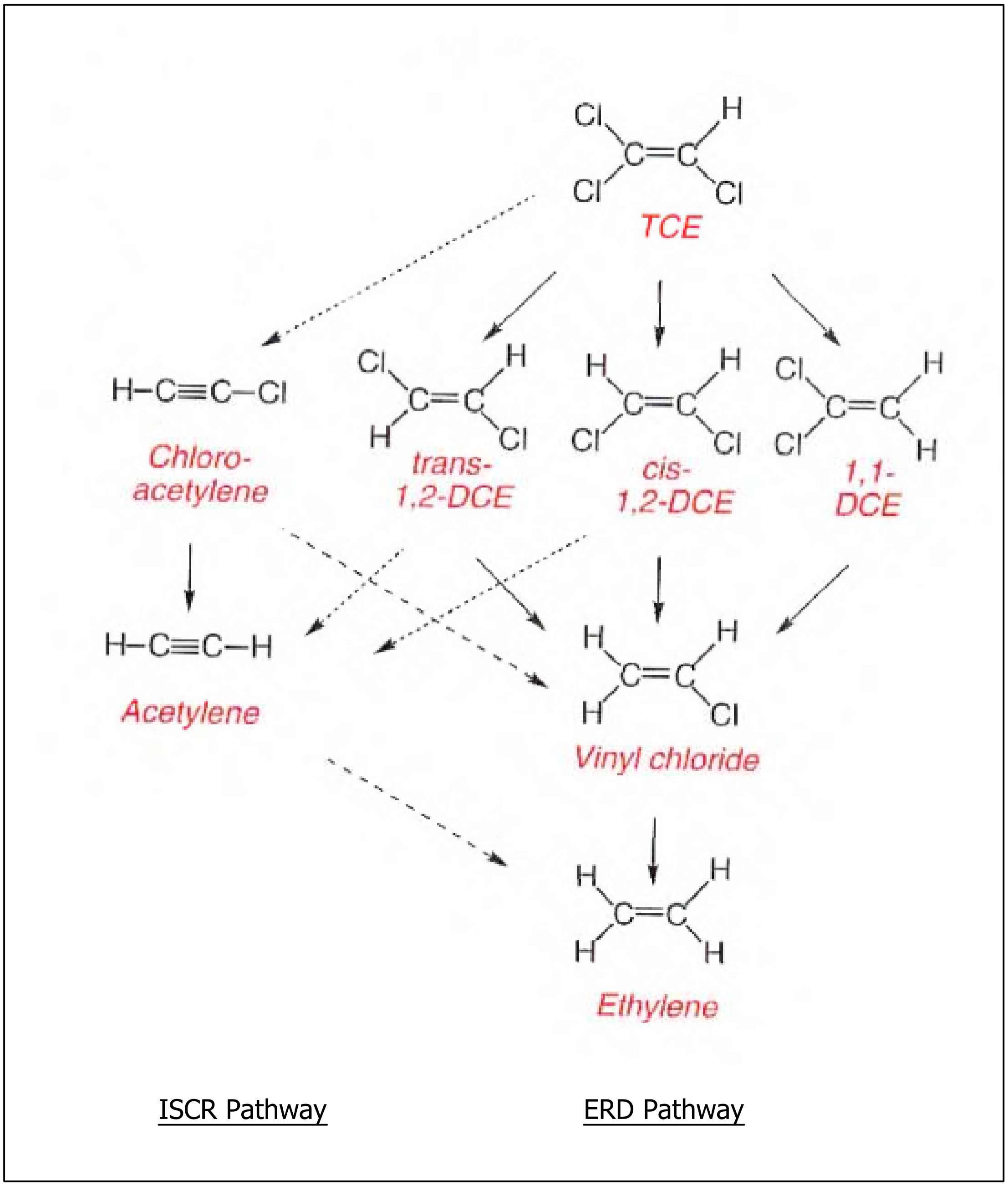
Cross-Section C-C'
SMI Holding LLC
455, 486/487, 501/505 East Middlefield Road
Mountain View, California

PLATE
6

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.004	37900705007_WPPT_3-6	GDT	6/19



ERD = Enhanced Reductive Dechlorination
ISCR = In-Situ Chemical Reduction
TCE = Trichloroethylene
DCE = Dichloroethylene

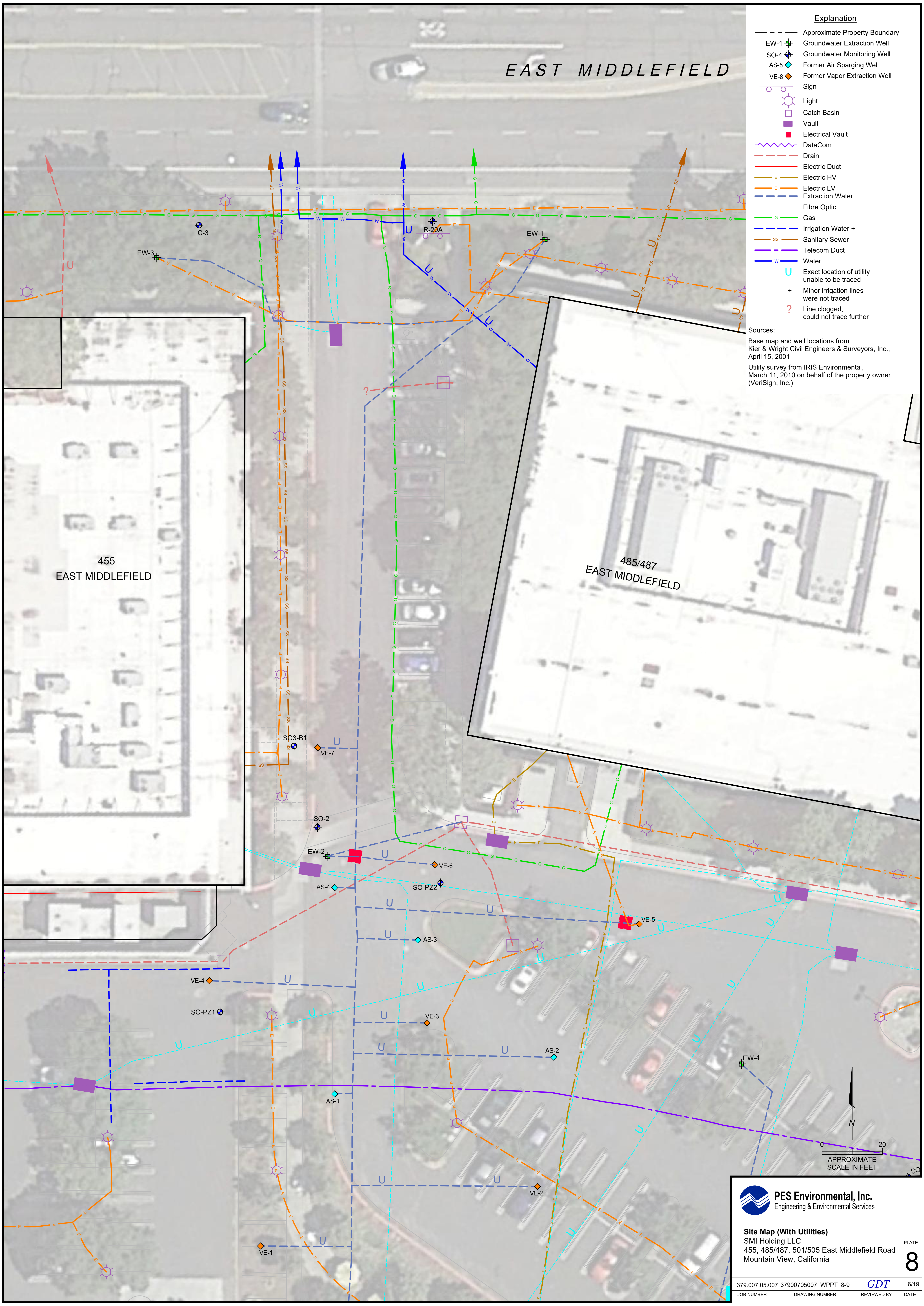
Excerpted from "Chlorinated Solvent Source Zone Remediation", SERDP/ESTCP, 2014

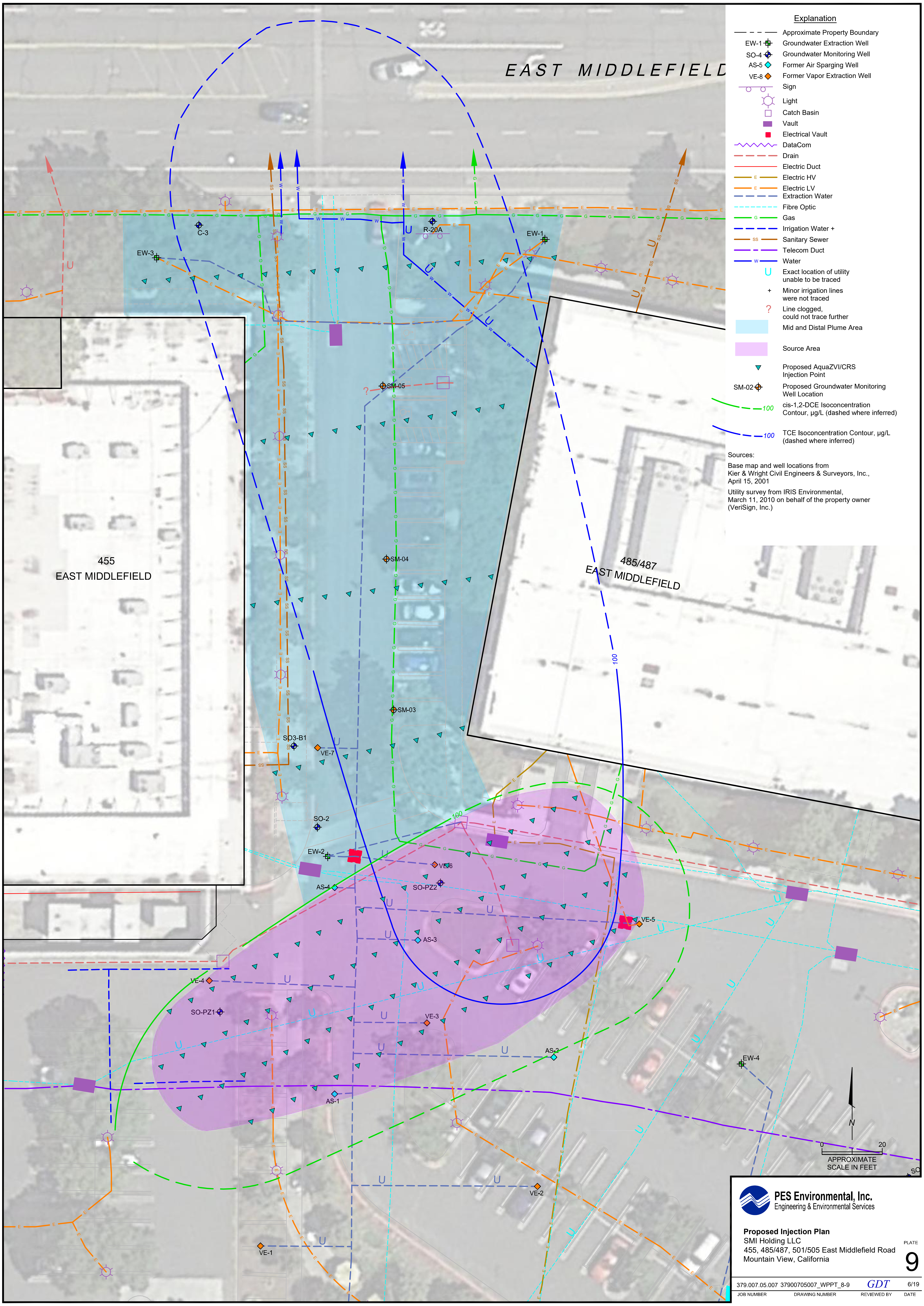
PES Environmental, Inc.
Engineering & Environmental Services

TCE Degradation Pathways
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

PLATE
7

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.004	37900705007_WPPT_7	GDT	6/19


EAST MIDDLEFIELD
455
EAST MIDDLEFIELD
485/487
EAST MIDDLEFIELD
C-3
EW-3
R-20A
EW-1
SO3-B1
VE-7
SO-2
EW-2
VE-6
AS-4
SO-PZ2
VE-5
AS-3
VE-4
SO-PZ1
VE-3
AS-2
EW-4
AS-1
VE-2
VE-1
Explanation
Approximate Property Boundary
EW-1 Groundwater Extraction Well
SO-4 Groundwater Monitoring Well
AS-5 Former Air Sparging Well
VE-8 Former Vapor Extraction Well
Sign
Light
Catch Basin
Vault
Electrical Vault
DataCom
Drain
Electric Duct
Electric HV
Electric LV
Extraction Water
Fibre Optic
Gas
Irrigation Water +
Sanitary Sewer
Telecom Duct
Water
Exact location of utility unable to be traced
Minor irrigation lines were not traced
Line clogged, could not trace further
Sources:
Base map and well locations from Kier & Wright Civil Engineers & Surveyors, Inc., April 15, 2001
Utility survey from IRIS Environmental, March 11, 2010 on behalf of the property owner (VeriSign, Inc.)
N
0
20
APPROXIMATE SCALE IN FEET
PES Environmental, Inc.
Engineering & Environmental Services
Site Map (With Utilities)
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California
PLATE
8
379.007.05.007
37900705007_WPPT_8-9
GDT
6/19
JOB NUMBER
DRAWING NUMBER
REVIEWED BY
DATE

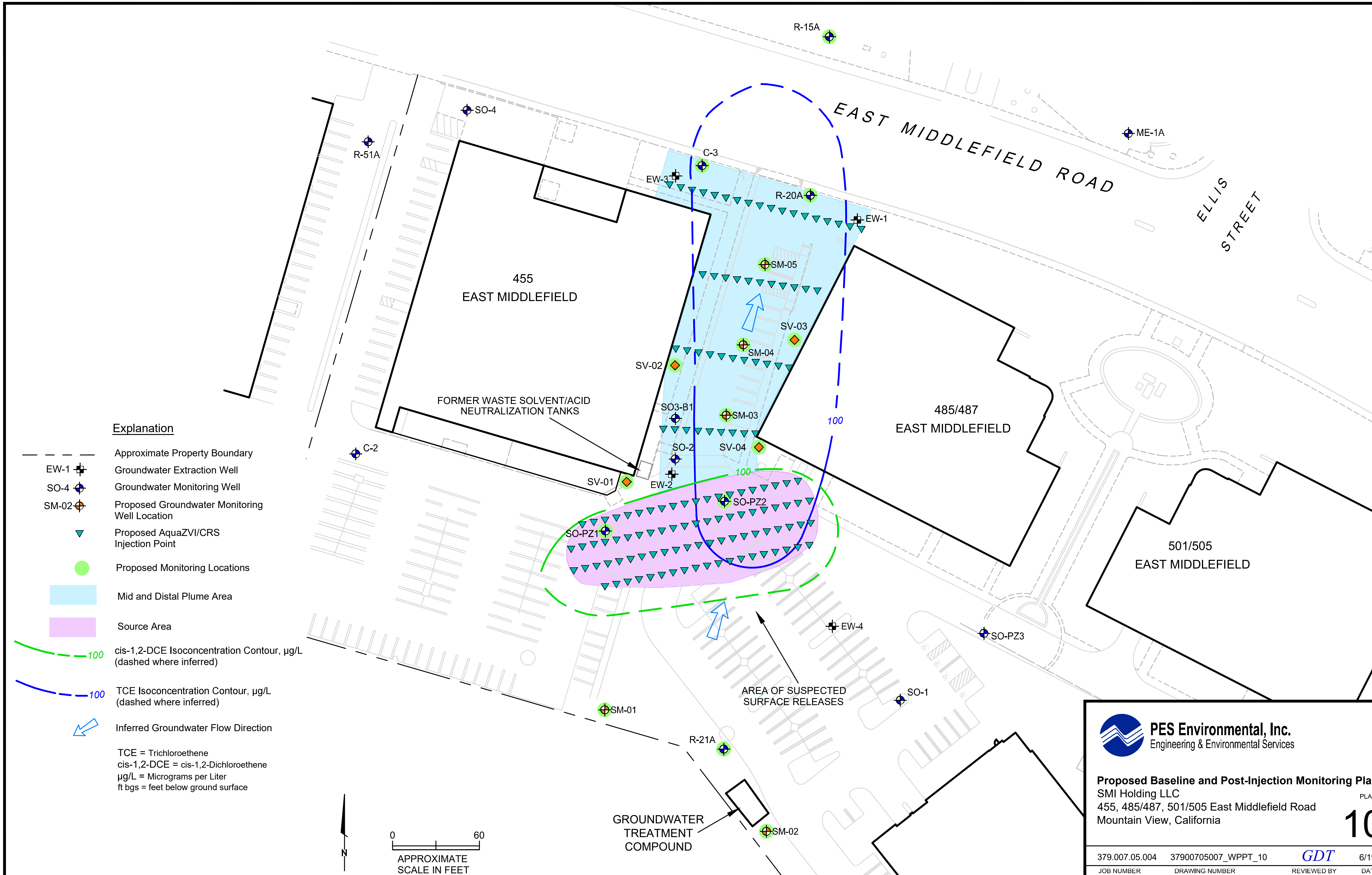


PES Environmental, Inc.
Engineering & Environmental Services

Proposed Injection Plan
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

PLATE
9

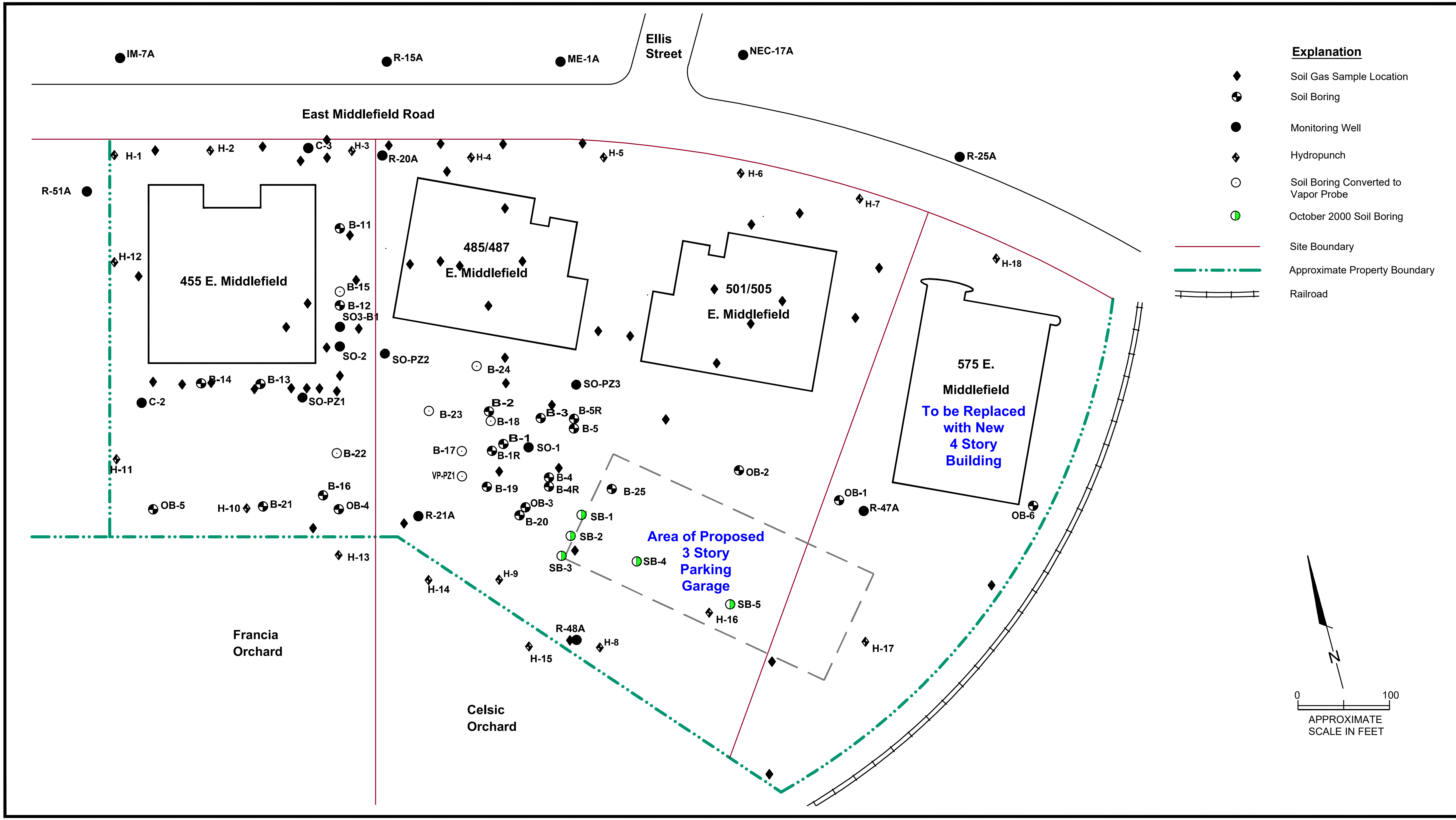
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
379.007.05.007	37900705007_WPPT_8-9	GDT	6/19



EAST MIDDLEFIELD ROAD
ELLIS STREET
455
EAST MIDDLEFIELD
485/487
EAST MIDDLEFIELD
501/505
EAST MIDDLEFIELD
R-15A
ME-1A
SO-4
R-51A
C-3
EW-3
R-20A
EW-1
SM-05
SV-03
SM-04
SV-02
100
SO3-B1
SM-03
FORMER WASTE SOLVENT/ACID NEUTRALIZATION TANKS
SO-2
SV-04
C-2
SV-01
EW-2
100
SO-PZ2
SO-PZ1
EW-4
SO-PZ3
AREA OF SUSPECTED SURFACE RELEASES
SO-1
SM-01
R-21A
GROUNDWATER TREATMENT COMPOUND
SM-02
N
0
60
APPROXIMATE SCALE IN FEET
Explanation
Approximate Property Boundary
EW-1 Groundwater Extraction Well
SO-4 Groundwater Monitoring Well
SM-02 Proposed Groundwater Monitoring Well Location
Proposed AquaZVI/CRS Injection Point
Proposed Monitoring Locations
Mid and Distal Plume Area
Source Area
100 cis-1,2-DCE Isoconcentration Contour, µg/L (dashed where inferred)
100 TCE Isoconcentration Contour, µg/L (dashed where inferred)
Inferred Groundwater Flow Direction
TCE = Trichloroethene
cis-1,2-DCE = cis-1,2-Dichloroethene
µg/L = Micrograms per Liter
ft bgs = feet below ground surface
PES Environmental, Inc.
Engineering & Environmental Services
Proposed Baseline and Post-Injection Monitoring Plan
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California
PLATE
10
379.007.05.004
JOB NUMBER
37900705007_WPPT_10
DRAWING NUMBER
GDT
REVIEWED BY
6/19
DATE

APPENDIX A

PRIOR SITE ASSESSMENT LOCATIONS

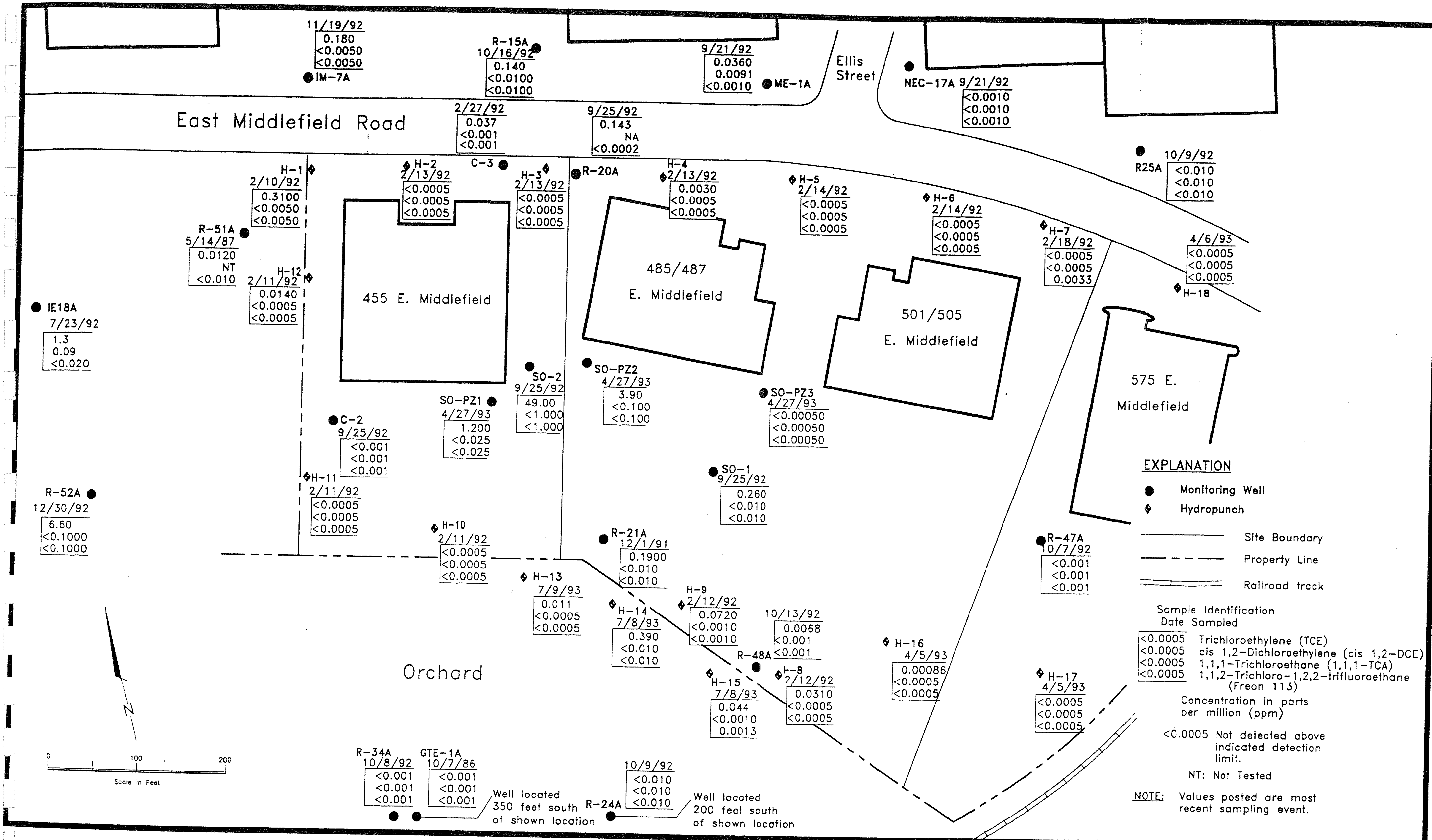


PES Environmental, Inc.
Engineering & Environmental Services

Site Plan
Sobrato Development Companies
East Middlefield Road Properties
Mountain View, California

PLATE
1

126-037-01-002	126037_1000	Final 10/24/00	10/00
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



PES Environmental, Inc.
Engineering & Environmental Services

Volatile Organic Compounds in A Aquifer Groundwater
Sobrato Development Companies
East Middlefield Road Properties
Mountain View, California

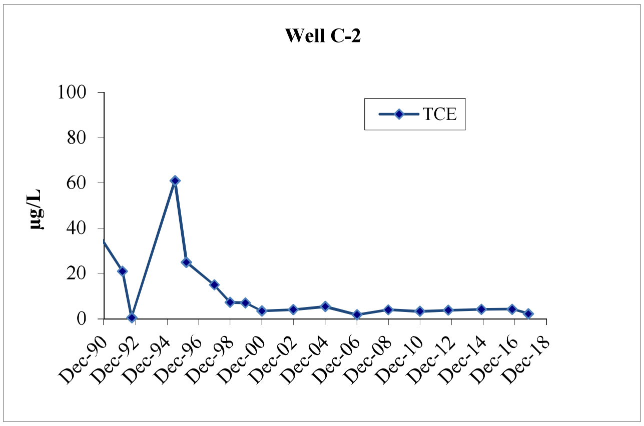
PLATE
12

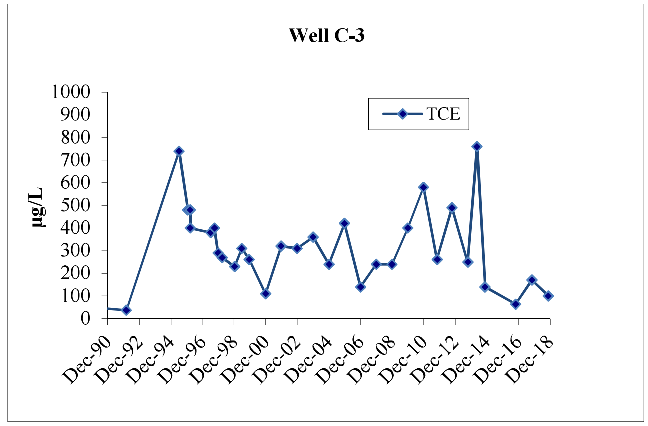
126.0201.004	126VOCBN	JmO	7/93	
JOB NUMBER	DWG NUMBER	REVIEWED BY	DATE	REVISED DATE

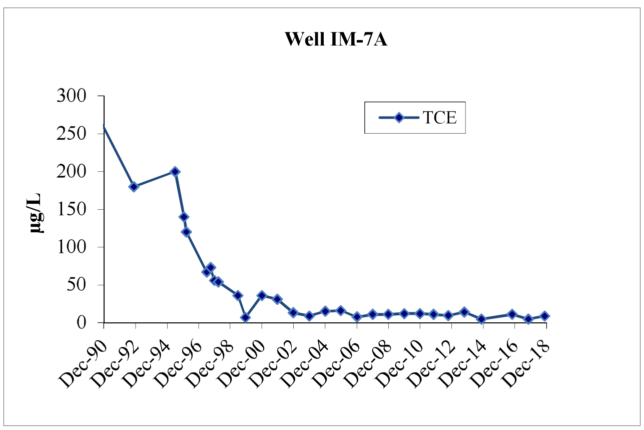
APPENDIX B

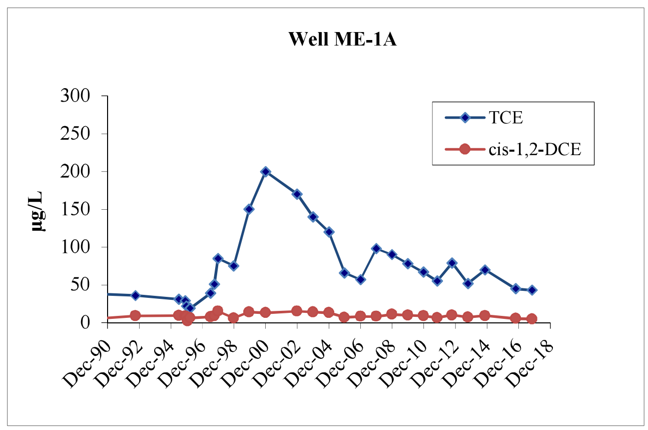
GROUNDWATER CONCENTRATION TRENDS

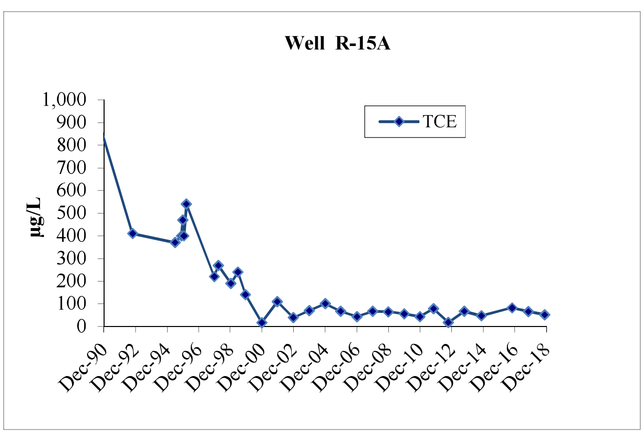
Plate B1
Monitoring and Extraction Well Concentration Trends
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

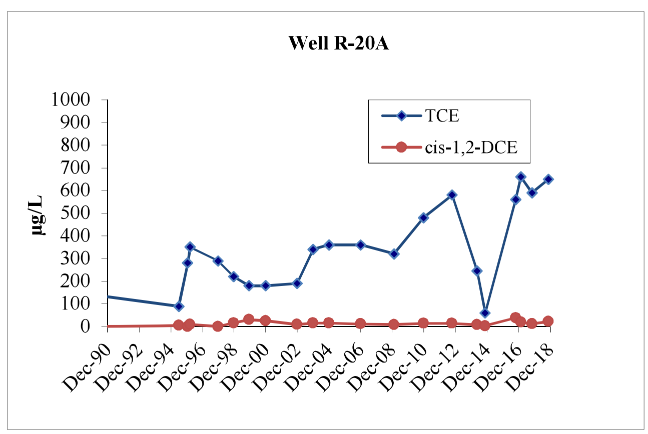






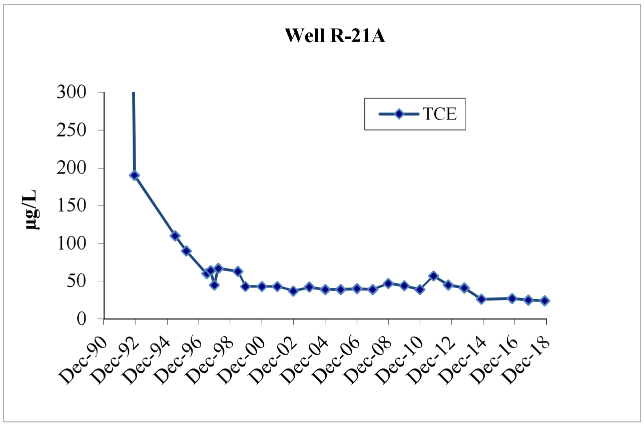


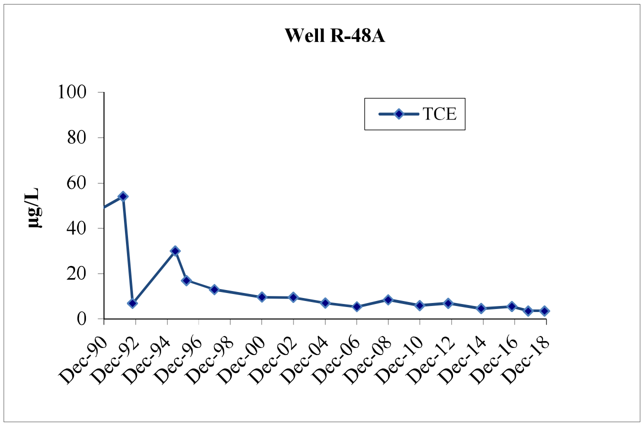


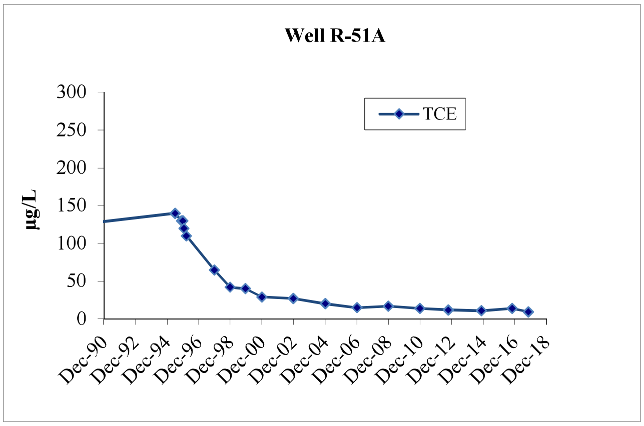


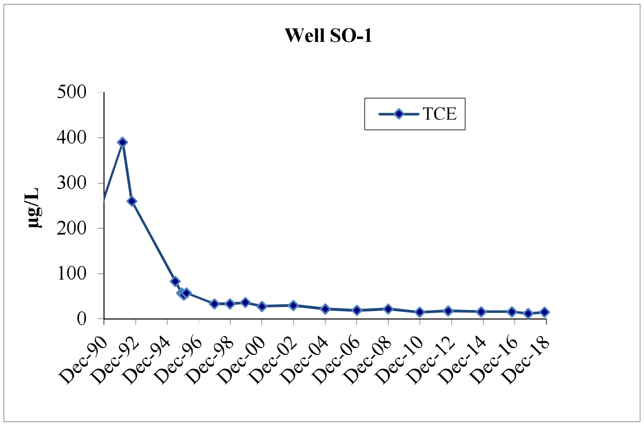
Notes:
μg/L = micrograms per liter.
TCE = trichloroethylene; cis-1,2-DCE = cis-1,2-dichloroethylene.

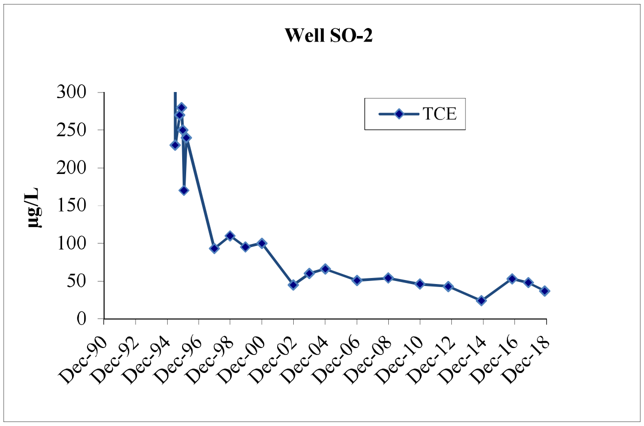
Plate B2
Monitoring and Extraction Well Concentration Trends
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

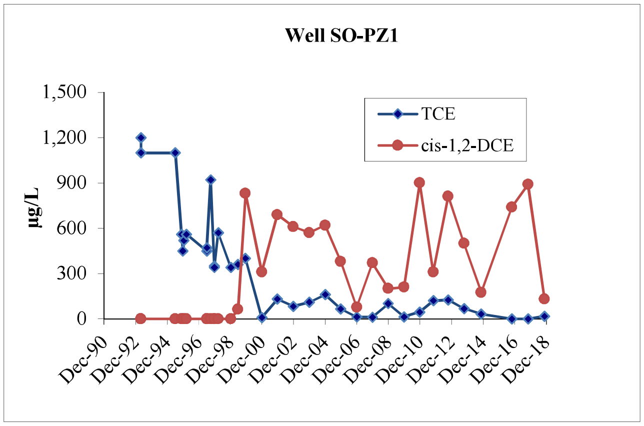






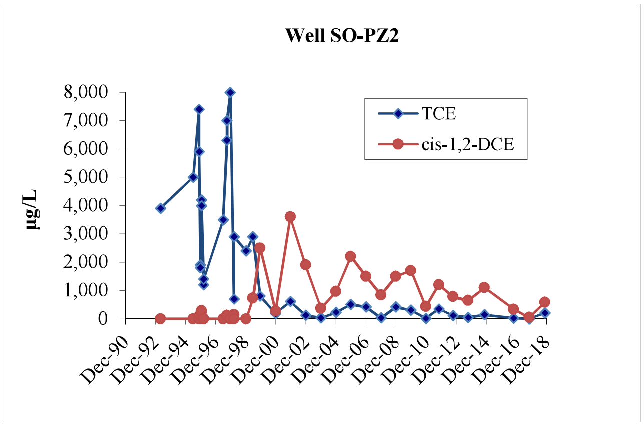


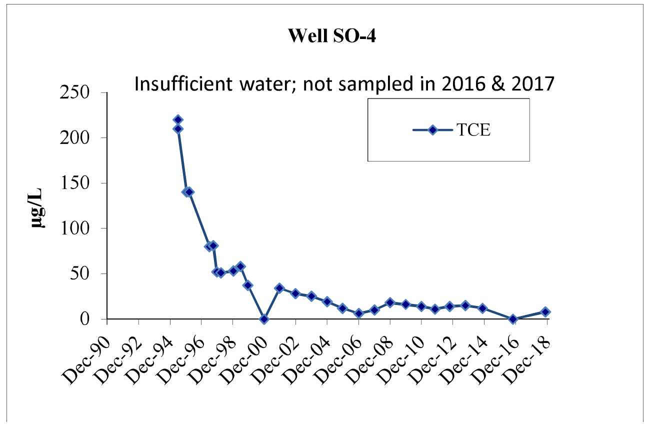


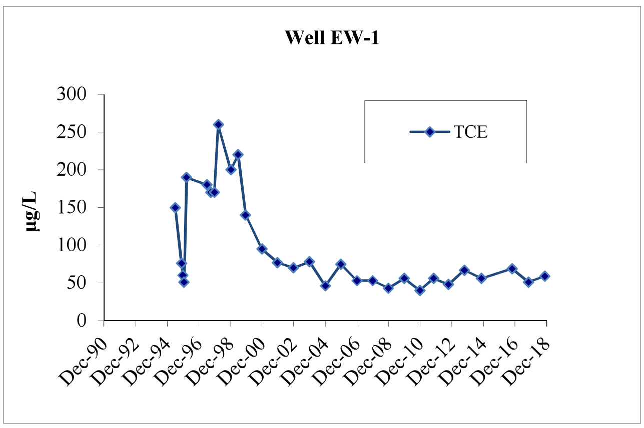


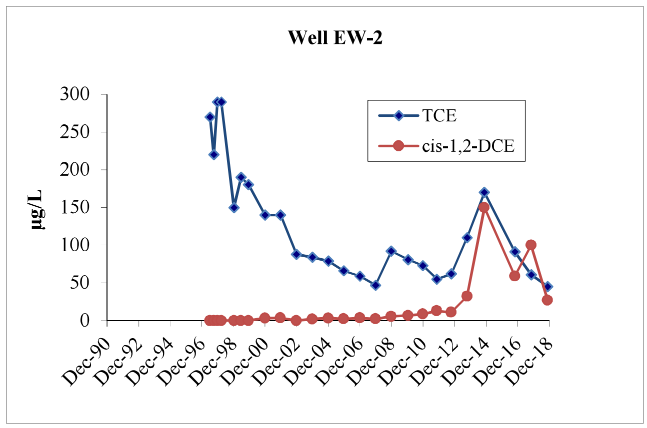
Notes:
µg/L = micrograms per liter.
TCE = trichloroethylene; cis-1,2-DCE = cis-1,2-dichloroethylene.

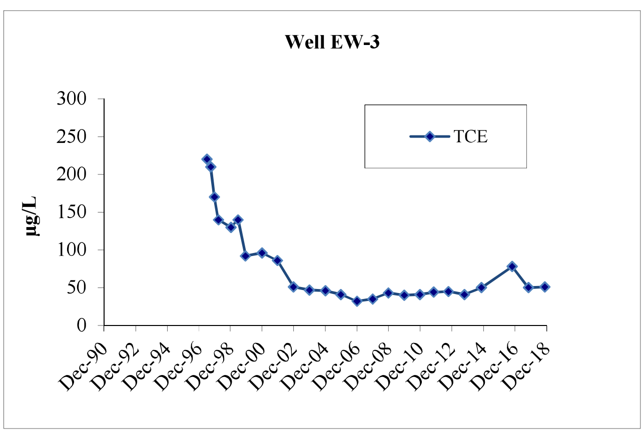
Plate B3
Monitoring and Extraction Well Concentration Trends
SMI Holding LLC
455, 485/487, 501/505 East Middlefield Road
Mountain View, California

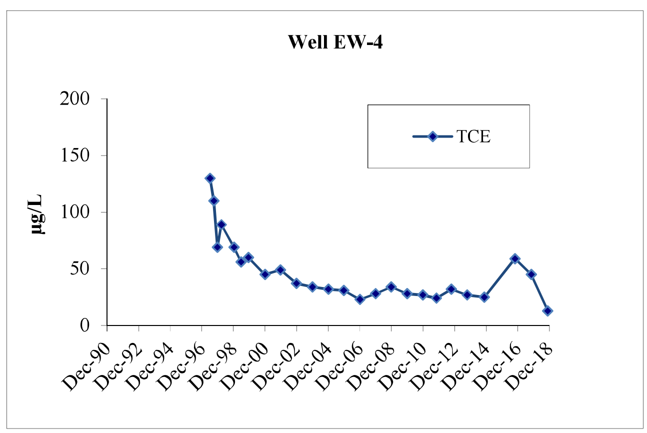












Notes:
µg/L = micrograms per liter.
TCE = trichloroethylene; cis-1,2-DCE = cis-1,2-dichloroethylene.

APPENDIX C

REAGENT SPECIFICATION SHEETS

AquaZVI Specification Sheet

AquaZVI Technical Description

AquaZVI™ is an *In Situ* Chemical Reduction (ISCR) reagent that promotes the destruction of many organic pollutants and is most commonly used with chlorinated hydrocarbons. It is engineered to provide an optimal source of micron-scale zero valent iron (ZVI) that is both easy to use and delivers enhanced reactivity with the target contaminants of concern via multiple pathways. AquaZVI will stimulate anaerobic biological degradation by rapidly creating a reducing environment favorable for reductive dechlorination. In many cases this improved formulation of ZVI can also destroy contaminants through a direct chemical reaction, see Figure 1.

AquaZVI is composed of colloidal, sulfidated zero-valent iron (ZVI) particles suspended in an aqueous medium with environmentally-acceptable, proprietary dispersants. The passivation technique of sulfidation, completed through proprietary processing methods, provides unparalleled reactivity with chlorinated hydrocarbons like PCE and TCE, and increases its stability and longevity *in situ* by minimizing undesirable side-reactions.

In addition to superior reactivity, AquaZVI is designed for easy handling that is unmatched by any ZVI material on the market. Shipped as an aqueous suspension, AquaZVI requires no powder feeders, no thickening with guar, and pneumatic or hydraulic fracturing is not mandatory. When diluted with water in the field, the resulting suspension is easy to mix and inject using direct push or injections wells.

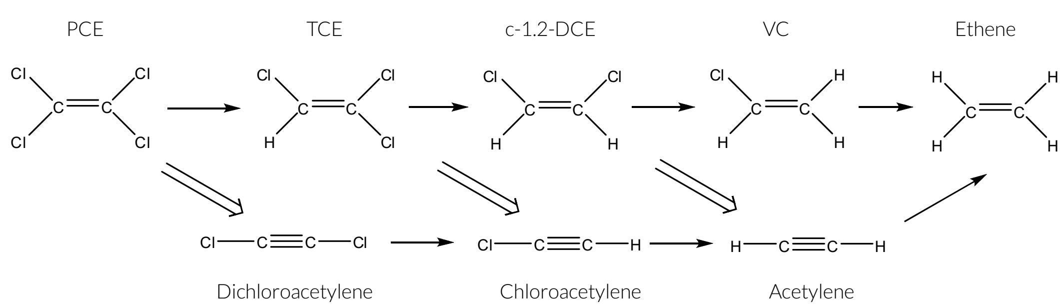


Figure 1. Example of chlorinated ethene degradation pathways and products. The top line with single-line arrows represents the reductive dechlorination (hydrogenolysis) pathway. The downward facing double-arrows represent the abiotic beta-elimination pathway.

To see a list of contaminants treatable by AquaZVI, view the Range of Treatable Contaminants Guide.

AquaZVI Specification Sheet

Chemical Composition

Iron, powders CAS 7439-89-6
Iron(II) sulfide CAS 1317-37-9

Properties

Physical State: Liquid
Form: Viscous metallic suspension
Color: Dark gray
Odor: Slight
pH: Typically 7-9 as applied
Density: 14 lbs/gal

Storage and Handling Guidelines

Storage:

- Use within two weeks of delivery
- Store at temperatures above freezing and below 95°F
- Store in original containers
- Store away from incompatible materials

Handling:

- Never mix with oxidants or acids.
- Wear appropriate personal protective equipment
- Do not taste or swallow.
- Observe good industrial hygiene practices.

Applications

AquaZVI is diluted with water on site and easily applied into the subsurface through low-pressure injections. AquaZVI can also be mixed with products like 3-D Microemulsion® or PlumeStop® prior to injection.

Health and Safety

Material is relatively safe to handle; however, avoid contact with eyes, skin and clothing. OSHA Level D personal protection equipment including: vinyl or rubber gloves and eye protection are recommended when handling this product. Please review the Safety Data Sheet for additional storage, usage, and handling requirements here: AquaZVI SDS.

REGENESIS
www.regenesis.com
1011 Calle Sombra, San Clemente CA 92673
949.366.8000

CHEMICAL
REDUCING
SOLUTION

CRS® Technical Description

Example of CRS

CRS® (Chemical Reducing Solution) is an iron-based reagent that facilitates biogeochemical *in situ* chemical reduction (ISCR) of halogenated contaminants such as chlorinated ethenes and ethanes. CRS is a pH neutral, liquid iron solution that is easily mixed with 3-D Microemulsion® Factory Emulsified before injection into a contaminated aquifer. CRS provides a soluble, food-grade source of ferrous iron (Fe^{2+}), designed to precipitate as reduced iron sulfides, oxides, and/or hydroxides. These Fe^{2+} minerals are capable of destroying chlorinated solvents via chemical reduction pathways, thus improving the efficiency of the overall reductive dechlorination process by providing multiple pathways for contaminant degradation in groundwater.

For a list of treatable contaminants with the use of CRS, view the Range of Treatable Contaminants Guide.

Chemical Composition

• Water	7732-18-5
• Ferrous Gluconate	299-29-6

Properties

- Appearance – Dark green to black
- Odor – Odorless
- pH 6.0 to 8.0
- Density – Approximately 1.0 grams per cubic centimeter (0.9 to 1.1 g/cc)
- Solubility – Miscible
- Vapor Pressure – None
- Non-hazardous

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store away from incompatible materials
Recommended storage containers: plastic-lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass
Store in a cool, dry, well-ventilated place
Keep away from extreme heat and strong oxidizing agents

Handling
Avoid prolonged exposure
Observe good industrial hygiene practices
Wear appropriate personal protective equipment
Avoid contact with eyes, skin, and clothing
Avoid breathing spray mist
Use with adequate ventilation

CHEMICAL REDUCING SOLUTION

CRS® Technical Description

Applications

- Permanent injection wells
- Direct-push injection points

Application instructions for this product are contained in the CRS Application Instructions.

Health and Safety

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200. Observe good industrial hygiene practices. Wash hands after handling. Store away from incompatible materials. Dispose of waste and residues in accordance with local authority requirements. Please review the CRS PLUS Material Safety Data Sheet for additional storage, usage, and handling requirements.

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APPENDIX D

MONITORING WELL INSTALLATION, DEVELOPMENT, SURVEY AND SAMPLING METHODS AND PROCEDURES

APPENDIX D

MONITORING WELL INSTALLATION, DEVELOPMENT, AND SAMPLING METHODS AND PROCEDURES

The proposed on-Site groundwater monitoring wells will be installed, developed, sampled, and surveyed in accordance with the procedures and method discussed below.

Task 1 - Field Planning Activities

Prior to conducting the well installation activities, PES Environmental, Inc. (PES) will:

- Obtain well construction permits from the Santa Clara Valley Water District (SCVWD);

- Procure subcontractors, equipment, and supplies needed to implement the scope of work discussed below;

- Contact Underground Service Alert to schedule visits by public and private utility companies to locate their underground utilities. In addition, a private underground utility locating subcontractor will be contracted to clear the locations for subsurface utilities; and

- As discussed in the work plan, at each boring location, an air knife vacuum truck, or hand-augering, will be used to clear the first 5 feet in advance of drilling.

Task 2 – Groundwater Monitoring Well Installations, Well Development, Well Survey and Well Sampling

Monitoring Well Installations

The monitoring wells will be installed by a licensed drilling contractor possessing a valid C-57 water well contractor’s license issued by the State of California using a rig that is capable of advancing direct-push tooling and hollow-stem auger. Prior to installing the monitoring wells at each location, a direct push drilling rig will be used to obtain a continuous soil core by advancing dual-walled sampling rod to anticipated total depth of the wells (i.e., approximately 30 feet below ground surface [bgs]). The collected lithology will be evaluated to determine the appropriate screen interval for the wells. A PES engineer or geologist will supervise the drilling and well construction activities, and prepare a lithologic log using the Unified Soil Classification System (USCS) and Munsell Color Index. The soil grain size will be classified based on field observations and by performing soil settling tube field tests. To perform these tests, a sample of soil will be placed in a 40-milliliter VOA vial filled with water. The sample will then be shaken to separate and hydraulically sort out the clays, silts, sands, and gravels. After the materials settle, a visual estimate will be made of the percentages of clays, silts, sands, and gravels in the sample.

The soil cores will be field screened for volatile organic compounds (VOCs) via headspace analyses using a photo-ionization detector (PID) and readings will be recorded on the lithologic log.

The monitoring wells will be installed using 6- to 8-inch diameter hollow-stem augers[47]. The screen intervals of the wells will be positioned to straddle first encountered groundwater and are anticipated to extend to maximum depths of approximately 30 feet bgs. As indicated in the main body of the report, it is anticipated that the shallow wells will be constructed with 15-foot screen intervals. The final construction depths will be determined based on field observations obtained during drilling and lithologic logging activities and will be selected to target permeable zones of the formation.

Upon reaching the desired depth interval, the monitoring wells will be constructed using 2-inch diameter schedule 40 polyvinyl chloride (PVC) casing and well screen. Wells screens will be constructed with 0.010-inch slots using No. 2/12 or No. 2/16 Monterey Sand as a filter pack. The sand filter pack of the wells will be extended from the bottom of the borehole to approximately 2 feet above the top of the well screen.

During well construction, the PVC well casing will be suspended to ensure vertical alignment and plumbness. The depth and proper placement of the annular materials will be measured and confirmed throughout the well installation process using a weighted tape or similar measuring device. The hollow-stem augers will be removed after/in conjunction with placement of the sand filter pack and borehole seals.

A minimum 2-foot thick hydrated bentonite pellet seal will be placed above the filter packs of the wells. In accordance with applicable regulations, the annular space above the bentonite seals of the wells will be tremie sealed with a neat cement grout to a depth of approximately 2 feet bgs. The blank casing in all the wells will be extended to approximately 0.5-foot bgs, and an expansion well cap will be used to secure and seal the top of each well casing. Traffic-rated, flush-mount vaults will be installed in concrete over the well heads for protection.

A State of California Well Completion Report for each well installation will be submitted to the SCVWD, as required.

<u>Monitoring Well Development Activities</u>

Following a minimum 72-hour period after placement of the sanitary seal, the monitoring wells will be developed by using a combination of bailing, swabbing, and pumping with a submersible pump. The objective of well development is to remove fine-grained material inside the filter pack and casing, to stabilize and sort the filter pack around the well screen,

[47] Should 4-inch diameter wells be installed, a larger diameter borehole will be completed. 4-inch diameter wells are preferable for potential future use as injection wells, if needed and only if future access for injections can be obtained (at this time, access for injections is only in July 2019).

and to produce representative water samples from the monitored zones. During well development activities water parameters including pH, temperature, conductivity, and turbidity will be monitored with field instruments. Well development will be continued until the discharge water is visually clear of sediment and the turbidity of the groundwater is less than 50 Nephelometric turbidity units (NTUs), if feasible.

Well Surveying

The top of the well casings will be surveyed by a California registered land surveyor, to obtain reference elevations relative to North American Vertical Datum of 1988 (NAVD88) and horizontal and vertical coordinates at each monitoring well location relative to North American Datum of 1983 (NAD83).

Well Sampling

PES will subcontract with Blaine Tech Services, Inc. (Blaine Tech) of San Jose, California to collect depth-to-groundwater measurements, and conduct groundwater monitoring well purging and sampling. Depth-to-groundwater measurements will be collected by Blaine Tech from the wells prior to commencing groundwater purging and sampling activities. These measurements will be recorded to the nearest 0.01-foot. To minimize the potential for cross-contamination of wells during the collection of the measurements, the portion of the probe that contacts the well casing or product/groundwater will be cleaned with a Liqui-Nox®-solution and double-rinsed with deionized water between measurements. Depth-to-groundwater measurements will be converted to groundwater-level elevations referenced to mean sea level[48].

Prior to the collection of groundwater samples from the new monitoring wells, water in each well casing will be purged using low-flow sampling methodology[49]. A low-flow bladder or electrical submersible pump will be placed at the approximate mid-point of the saturated portion of the well screen, and the sampling protocol included: (1) purging the well at a flow rate of approximately 100 to 200 milliliters per minute (mL/min); (2) measuring water quality parameters including temperature, pH, electrical conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity; and (3) collecting groundwater samples after water quality parameters had stabilized to within approximately 10% of the prior reading. Water quality measurements will be recorded by Blaine Tech. After purging of the well, the groundwater samples will be collected from the discharge tubing at the end of the pump into clean, laboratory-supplied sample containers. To reduce the potential for cross-contamination of wells during well purging, a new pump bladder, grab plate, and pump tubing will be used, and the submersible pump housing will be triple-rinsed with a Liqui-Nox® solution prior to purging each well.

[48] If applicable, groundwater levels are adjusted for FPLH thickness, such that Groundwater Elevation = TOC Elevation - (Depth to water - [0.84* FPLH Thickness]).

[49] Puls, R.W. & Barcelona, M.J., 1996. USEPA Ground Water Issue. *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures*. Publication Number EPA/540/S-95/504. April.

Field quality assurance/quality control (QA/QC) samples for groundwater monitoring events will consist of one duplicate, one field blank and one equipment blank will be collected for every 10 samples collected for VOC analysis. In addition, a laboratory provided trip blank will be included with each cooler containing groundwater samples for VOC analysis that is sent to the laboratory.

The sample bottles will be labeled, packaged, and stored in a chilled, thermally insulated cooler until delivery to the laboratory. Each sample will be assigned a sample number and logged on the Chain-of Custody Record. A Chain-of-Custody Record will accompany each sample shipment to the laboratory to document sample possession from the time of collection. Groundwater samples from the new wells will be submitted to the laboratory for analysis as discussed in Section 4.5.1 of the work plan.

The duplicate, field blank, equipment blank, and trip blanks will be analyzed for VOCs only.

Groundwater samples for dissolved gases (methane, ethane, ethene, and acetylene) analyses will be transported under chain-of-custody documentation to Pace Analytical (Pace) in Pittsburgh, Pennsylvania (which has a lower reporting limit) than local laboratories). The remaining groundwater samples will be transported under chain-of-custody documentation to Eurofins TestAmerica (TestAmerica), of Pleasanton, California.

Task 3 - Handling, Storage, and Disposal of Investigation-Derived Wastes

Investigation derived waste (IDW) generated during the installation, development and sampling of the groundwater monitoring wells will be temporarily stored on-Site. The IDW will be stored in secured, labeled Department of Transportation (DOT)-approved 55-gallon steel drums, until proper off-site management in accordance with applicable State and Federal laws can be arranged. The IDW will be disposed or recycled based on the results of the laboratory analyses.

APPENDIX E

PERMANENT SOIL VAPOR PROBE INSTALLATION AND SAMPLING METHODS AND PROCEDURES

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PERMANENT SOIL VAPOR PROBE INSTALLATION AND SAMPLING METHODS AND PROCEDURES

Each permanent soil vapor location will consist of a probe with a soil vapor inlet placed at approximately 7 feet below ground surface (bgs). The probes will be installed using a hand auger (for the upper 5 feet) or direct-push drilling equipment (beyond a depth of 5 feet bgs). Soil will be continuously cored and logged. A PES geologist or engineer will supervise the drilling and probe installation activities and prepare a lithologic log of each boring using the Unified Soil Classification System (USCS) and Munsell Color Index. The continuous soil cores will be utilized to identify lithologic conditions within the target depth of the probes. The installation and sampling of the probe will be conducted in accordance with the procedures outlined in the *Advisory for Active Soil Gas Investigations* (ASGI) published by the Department of Toxic Substances Control, the Regional Water Quality Control Board, Los Angeles Region and the California Regional Water Quality Control Board, San Francisco Bay Region dated July 2015[1].

The soil vapor probes will be constructed within the direct-push sampler rods, utilizing a stainless-steel vapor probe tip, fitted with ¼-inch outside-diameter Teflon® tubing. The stainless-steel vapor probe tip for each sample interval will be placed at the midpoint of a 1-foot minimum sand pack that will be placed at the bottom of the borehole. The sand pack will consist of No. 2/12 sand. A 6-inch minimum dry granular bentonite will be placed above the sand pack followed by neat cement grout with one to five percent bentonite above the layer of dry granular bentonite seal. A 4- to 6-inch diameter steel, flush-mounted Christy box will be installed at the surface to protect the probes. Each soil vapor probe will be labeled and fitted with a compression valve. The soil vapor probes will be allowed to equilibrate for a minimum of 48 hours prior to purging and gas sampling.

Prior to the collection of soil vapor samples, shut-in leak testing, purging, and sample train leak testing will be performed. The shut-in test will consist of assembling above-ground sampling apparatus (e.g., valves, lines, and fittings downstream from the top of the probe) and evacuating the lines to a measured vacuum of approximately 100 inches of water column (in-H_2O), then shutting the vacuum in with closed valves on opposite ends of the sampling train. A vacuum gauge will be used to assess if there is any observable loss of vacuum (for at least one minute) prior to purging and the collection of soil vapor samples. If observable vacuum loss is noted, the sample train will be re-assembled, and the shut-in test will be repeated. This process will be repeated as necessary until a successful shut-in test has been performed.

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[1] DTSC, 2015. *Advisory - Active Soil Gas Investigations*. Jointly developed by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) and RWQCB - San Francisco Region (SFRWQCB). July.

A default of three purge volumes will be extracted prior to collecting the soil vapor samples. The stagnant air will be purged with a six-liter Summa canister. The purge volume will be calculated using the volumes of: (1) the internal volume of the tubing; (2) the void space of the sand pack around the probe tip; and (3) the void space of the dry bentonite in the annular space. In accordance with the ASGI, purging and collection of soil vapor samples will be performed using a flow rate of 100 to 200 milliliters per minute (mL/min) and maintaining a low vacuum of less than 100 inches of water to mitigate ambient air breakthrough into samples.

Following completion of the shut-in leak test and purging, sample train leak testing will be performed using a propellant tracer in combination with a shroud box. The shroud box will consist of a polycarbonate box equipped with an access port to allow charging of the box with a propellant tracer. The shroud box will be positioned over the probe. Once in position, the sample train will be connected to a 1-liter soil vapor sample Summa canister. The shroud box will cover the sample train (including the Summa canisters, valves, lines, flow controllers, and fittings) and will be charged by spraying the tracer propellant into the shroud box. The shroud box will be allowed to remain in place for the duration of sampling. For quality assurance/quality control (QA/QC) evaluation, a second 1-liter Summa canister will be placed within the shroud and used to collect a shroud air sample concurrent with each soil vapor sample. The shroud air sample will be analyzed for the tracer gas only to quantitatively assess representative leak check compound concentrations in the shroud.

1-liter vapor sample Summa canisters and flow controllers that are batch-certified clean by a California-certified analytical laboratory will be utilized to collect the soil vapor sample and 1-liter vapor sample Summa canisters and flow controllers that are batch-certified clean by a California-certified analytical laboratory will be utilized to collect the shroud samples. Each shroud and soil vapor sample canister will be filled until the vacuum gauge reads approximately 5 inches of mercury (Hg) or less. Extra canisters and flow controllers will be ordered from the laboratory in the event that the initial vacuum in one of the canisters is too low (indicative of leakage) or if the flow controllers do not operate properly (the vacuum drops too rapidly) during sample collection. Field QA/QC samples for the soil vapor monitoring will consist of one duplicate sample for every 10 samples collected for VOC analysis. The duplicate sample will be collected concurrent with the collection of the primary sample.

After sampling, the Summa canisters will be transported to the analytical laboratory under chain-of-custody protocol. The soil vapor and duplicate samples will be analyzed by K-Prime Inc. (K-Prime), of Santa Rosa, California for the analytes listed in Section 4.5.2. of this work plan.

The shroud samples will be analyzed for the propellant tracer by U.S. EPA Test Method TO-3 only.

To reduce the potential for cross-contamination between sampling locations, downhole soil vapor equipment will be thoroughly cleaned prior to initiating work at each sampling location with either: (1) a dilute Alconox solution, rinse with potable water, and final rinse with distilled water; or (2) a high-pressure hot water wash.

Investigation-derived waste (IDW) generated during the installation of the soil vapor probes wells will be temporarily stored on-Site. The IDW will be stored in secured, labeled Department of Transportation (DOT)-approved 55-gallon steel drums, until proper off-site management in accordance with applicable State and Federal laws can be arranged. The IDW will be disposed or recycled based on the results of the laboratory analyses.

APPENDIX F

CONTINGENCY PLAN

APPENDIX F

CONTINGENCY PLAN

F1 TRIGGERS FOR CONTINGENCY PLAN

For groundwater and soil vapor, there is a potential for increased VOC concentrations due to:

- Desorption from the soil matrix during treatment and/or naturally occurring soil matrix diffusion. As the groundwater concentrations are reduced due to treatment, the resultant concentration gradient can increase the diffusion of VOCs absorbed onto the soil matrix (i.e., soil matrix diffusion). Soil matrix diffusion is already occurring as evidenced by fluctuating groundwater concentrations;

- Discontinuation of groundwater extraction and treatment system; this will likely effect extraction wells the most as during operation, the wells extract water from "cleaner" areas which dilutes concentrations in the immediate vicinity of the extraction well; and

- To address these concerns, this contingency plan will be implemented, as necessary.

F2 PRELIMINARY WORK

As discussed in this work plan, prior to completing the injections, a survey of known and potential vapor intrusion pathways in the buildings will be completed and these pathways will be sealed to minimize the potential for vapor intrusion. Known pathways include the electrical conduits that penetrate the floor that exist beneath the large electrical panels with the electrical rooms at both 455 EMR (southeast corner) and 487 EMR (southwest corner), in close vicinity to known potential source areas. This work could not be completed when the buildings were occupied by the current property owner, but as the buildings are empty, it is anticipated that the work can now be completed. Other known pathways include a fire riser at 487 EMR that is enclosed within a false building column. A low detection limit (i.e., parts per billion or ppb) photo-ionization detector will be used to survey potential pathways. A licensed electrical subcontractor will be used to seal potential pathways identified in the electrical rooms.

Prior indoor air sampling events completed at the Site, including with and without the heating, venting, and air conditioning (HVAC) systems operating (to the extent allowed by the property owner), indicate that indoor air concentrations are well below the cleanup levels provided in the VI Record of Decision (ROD) Amendment for the MEW Area (VI ROD Amendment)[1,2].

[1] EPA, 2010. *Record of Decision Amendment for the Vapor Intrusion Pathway, MEW Superfund Study Area.* August 16.

[2] PES, 2015. *Indoor Air Sampling Report, SMI Holding LLC, 455 and 485/487 East. Middlefield Road, Mountain View, California*. May 8

However, within 455 EMR, the indoor air sampling was not completed without all the HVAC units off because the building was occupied for 24 hours and some units needed to continue operation. The VI ROD Amendment indoor air cleanup levels for commercial property use are: 5.0 micrograms per cubic meter ($\mu g/m^3$) for TCE; 210 $\mu g/m^3$ for cis-1,2-DCE, and 2.0 $\mu g/m^3$ for vinyl chloride.

As discussed in this work plan, baseline indoor air sampling will be completed at 455 EMR and 485/487 EMR (including 455 EMR without HVAC operation).

To ensure no potential future vapor intrusion pathways are created during future tenant improvements, additional pathway evaluations (if needed) will be completed after such improvements[3]; these pathways will be sealed (if needed).

F3 INCREASED VOC CONCENTRATIONS IN GROUNDWATER

Although this is not expected to occur, should TCE concentrations in groundwater samples increase substantially over the baseline concentrations), more frequent groundwater monitoring will be initiated and indoor air sampling will be completed (as discussed in F4). Re-initiation of groundwater extraction would be initiated if increased VOC concentrations persist and if required by EPA and in consultation with the property owner.

F4 INCREASED VOC CONCENTRATIONS IN SOIL VAPOR

Should soil vapor VOC concentrations exceed (1) 1,000 times the VI ROD Amendment indoor air cleanup levels and (2) 100% of the baseline soil vapor concentrations (and baseline indoor air concentrations are less than the VI ROD Amendment cleanup levels), a confirmatory soil vapor sample will be collected. The confirmation sample data will be provided to EPA and the property owner within 24 hours of receipt of the results. If the soil vapor VOC concentrations in both samples exceed the trigger levels described above, indoor air in the nearby buildings (i.e., 455 and 487 EMR) will be sampled.

Indoor air sampling will be completed[4] to ensure that VOC concentrations remain below the VI ROD Amendment cleanup levels, EPA's interim TCE indoor air accelerated response action level of 7 $\mu g/m^3$ (commercial/industrial 10-hour workday), and/or EPA's interim TCE indoor air urgent response action level of 21 $\mu g/m^3$ (commercial/industrial 10-hour workday)[5].

[3] Property owner notification of tenant improvements is requested.

[4] Indoor air results will be shared with EPA and property owner within 24 hours of receipt of results.

[5] EPA, 2014. *EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion*. July 9.

If the urgent response action level is exceeded (which is considered to be unlikely), immediate actions would be undertaken as required by EPA.

If the accelerated response action level in indoor air is exceeded, appropriate response actions will be taken within five working days. The response actions could include: additional indoor air sampling to confirm results, completion of another VI pathway evaluation (with sealing if needed), increased operation of the HVAC system (with additional cost of utilities reimbursed by SMI), installation of portable indoor air filters, and/or installation of a sub-slab depressurization system in the area of concern.

If indoor air VOC concentrations are greater than the 2010 VI ROD Amendment cleanup levels, temporary measures to mitigate indoor air VOC concentrations to levels below the cleanup levels will be undertaken. In consultation with EPA and the property owner, these measures may include changes in HVAC operation or installation of portable indoor air filters and completion of another vapor intrusion pathway evaluation.

If the soil vapor concentrations decrease such that temporary mitigation measures may be terminated, indoor air sampling will be conducted with both HVAC on and off (if logistically feasible according to the property owner and tenant), to confirm that the indoor air VOC concentrations are below VI ROD Amendment cleanup levels.

If the higher VOC concentrations persist in soil vapor samples and result in persistent indoor air concentrations greater than the 2010 VI ROD Amendment cleanup levels, the response actions required by the VI ROD Amendment would be undertaken.

DISTRIBUTION

**WORK PLAN FOR SULFIDATED ZERO VALENT IRON
IN-SITU PILOT TEST
SMI HOLDING LLC
455 AND 485/487 EAST MIDDLEFIELD ROAD
MOUNTAIN VIEW, CALIFORNIA**

JUNE 17, 2019

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